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THE BRITISH SOMALILAND-ETHIOPIA BOUNDARY: *A paper read at the Evening Meeting of the Society on 20 January 1936, by*

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AN Arab sultanate with its capital at Zeila was founded by emigrants from the Yemen in, it is said, the seventh century A.D., and in the thirteenth century became powerful as the Empire of the Adals. It is interesting to note this name. Zeila is called by the Greek geographers *Ἀδυλη*, and Somalis to-day know it as Audal. In the sixteenth century the Arab influence was decreasing and the capital was transferred inland to Harar. This was the epic period of the Empire; Mohamed III, Ahamed ibn Ibrahim el Ghazi, the notorious Mohamed Gran of Ethiopian history, became emir in 1525 and before his death in 1543 had invaded, ravaged, and become virtual master of the greater part of Ethiopia. Thereafter the Empire was greatly harassed by Galla invaders in the seventeenth century and broke up into a number of petty independent emirates and sultanates, mostly Somali. Zeila became a dependency of the Yemen, and thus nominally part of the Turkish Empire. During the first half of the nineteenth century British influence—exercised by the East India Company, later by the Government of India—grew steadily on the south of the Gulf of Aden; but British authority was not established. In 1874–75 Egypt occupied Tajura, Bulhar, Berbera, and Harar, obtained a *firman* from Turkey by which Zeila became Egyptian, and secured British recognition of her jurisdiction as far east as Cape Gardafui. But, in consequence of the situation in the Sudan, all Egyptian garrisons were withdrawn in 1884–85. Great Britain then occupied Zeila, Bulhar, and Berbera, in order to secure the Red Sea route to the Far East and also the supply of fresh meat for Aden; Turkey being given the option of resuming possession of Zeila, an option which was not taken up. At the same time France annexed the Danakil and Somali coasts at present held by her. An Arab emirate was established in Harar as a buffer state, but fell early in 1887 to the arms of Menelik II, King of Shoa and shortly to become Emperor of Ethiopia. During 1884–86 treaties of protection were concluded with the various Somali tribes, considerable rivalry resulting in the western part of the country between ourselves and

the French. A number of entertaining anecdotes of this period have been related by Mr. Prendergast-Walsh in his book 'Under the Flag and Somali Coast Stories.' Early in 1888 an Agreement was signed with France, defining the boundary between French and British spheres of influence, extending inland as far as Harar, but imposing self-denying ordinances on both parties as regards Harar itself. The boundary between British and Italian spheres was next defined, by the Anglo-Italian Protocol of May 1894.

Then came the Franco-Ethiopian Boundary Convention of 20 March 1897; and, on its way back to the coast, the French party was passed by a British Mission to the Emperor Menelik, headed by Mr. Rennell Rodd (now Lord Rennell of Rodd). The labours of this Mission resulted in the Treaty of 14 May 1897, the boundary clauses of which are expressed in an appendix negotiated at Harar with Ras Makonen, father of the present Emperor. When the discussions were opened, Mr. Rodd was confronted with a circular letter which the Emperor had addressed to the heads of all European states on 10 April 1891, in which he made a declaration of the frontiers of Ethiopia. This had never reached London, though an inaccurate translation had appeared in *La France Militaire* in March 1896. The agreed line was a compromise between the Emperor's claims and that of the Anglo-Italian Protocol of 1894. The great objection to it is the administrative one that it cuts across tribal areas, though this was met by the inclusion of a trans-frontier grazing clause. But in any case the difficulty is not entirely avoidable with these nomad tribes whose areas overlap in the most confusing manner. There the matter remained until 1924, when the present Emperor, then Regent and known as Ras Tafari Makonen, during his visit to Europe expressed the desire to see all the frontiers of Ethiopia demarcated. Great Britain, alone of his neighbours, paid any serious attention, and it was agreed that a start should be made with the Somaliland frontier. Negotiations to this end proceeded slowly but on the whole surely, and at the end of 1930 reached the stage of definite preparations; but the Boundary Commission did not actually meet until 8 January 1932, at Berbera.

The general configuration of Somaliland has often enough been described. I will therefore confine myself to remarks on the parts we worked through. The Haud is a vast area of thorn bush desert sloping very uniformly southwards, with little, or only very minor, physical relief. It contains no permanent water except at Doomo (Damot on current maps) and Harodiget; in fact it is the position of the permanent water points round it that determines its limits. It is nevertheless a region of the utmost importance to the tribes on account of its grazing. From the point of mapping, the principal features are the water points: mostly depressions called *bale* or *hara* which hold rainwater; and the tracks. Most of the latter run north and south, and until very recently were caravan routes leading principally to Berbera or Bulhar. The development of Ethiopian control has however diverted trade *via* Dagahbur and Jijiga, and motor transport has put the seal on this change. So that now these tracks are virtually only used as the guiding lines for the seasonal migrations of the tribes. West of the line Hargeisa–Dagahbur it is very striking how all the tracks swing round westwards to Jijiga; there can be little doubt that originally they led over passes on the watershed between the Fafan and Jerer basins, and that

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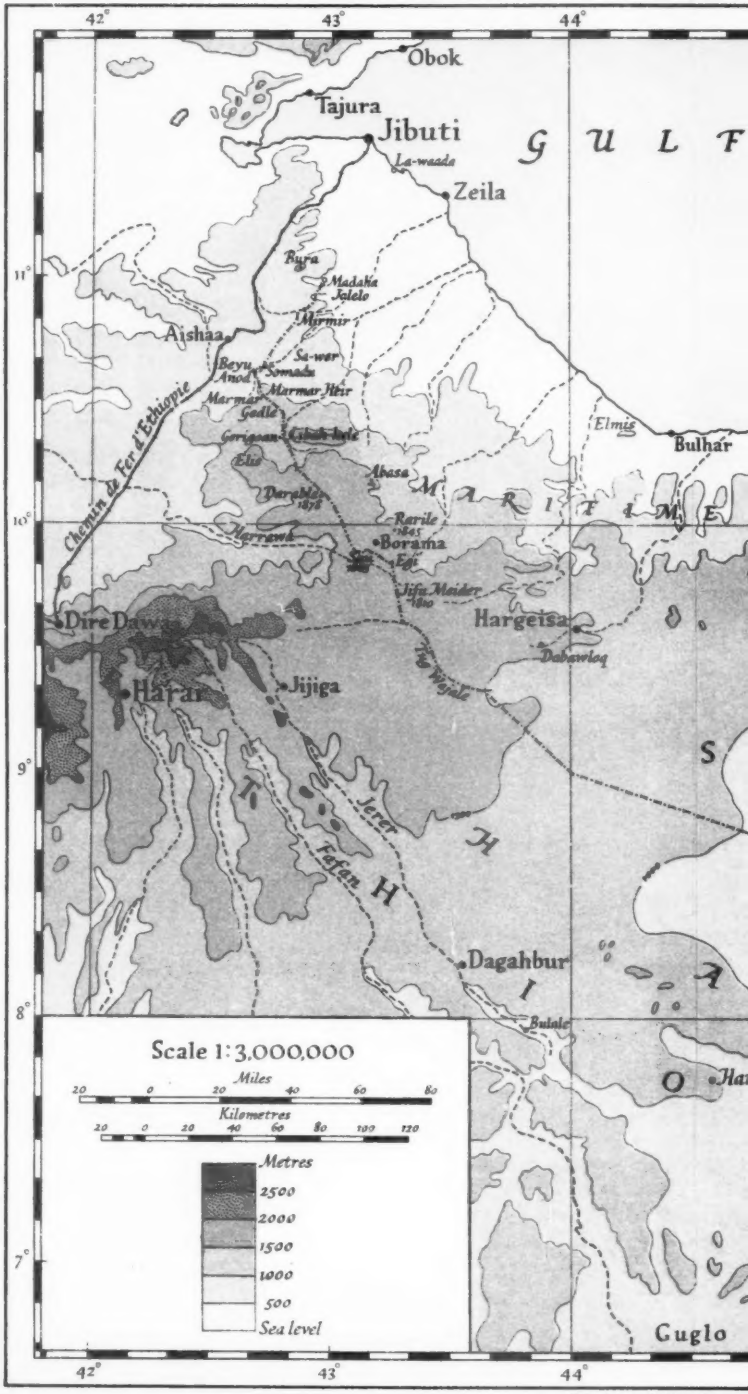
To accompany the paper by Lt.-Col. E



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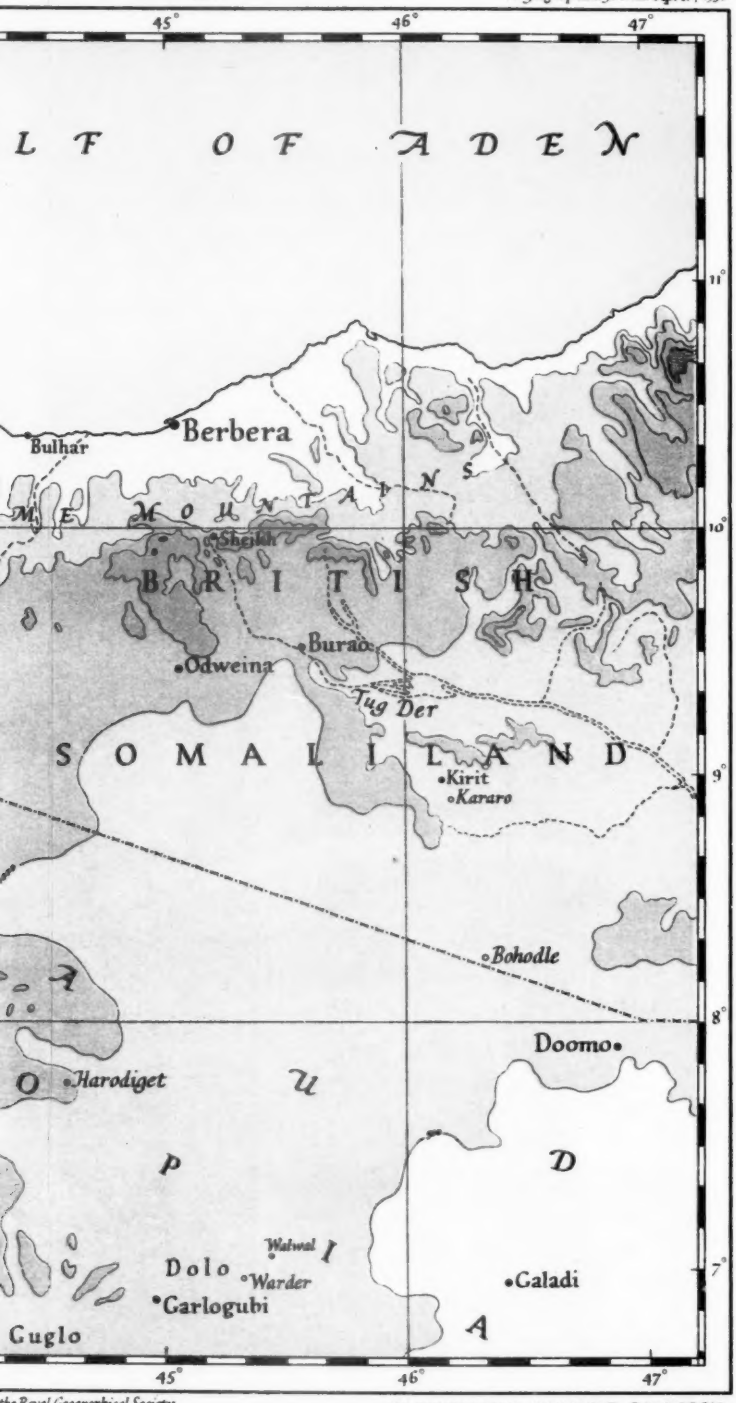

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BR. SOMALILAND-ETHIOPIA BOUNDARY
Clifford

the growth of Jijiga has been responsible for the change. Though the Haud includes many open stretches, as a wide generalization it is fair to say that in the east and south it is thick, even very thick, thorn bush, and in the north-west parkland. I feel that this is probably partly a result of the disturbed period of the activities of Mohamed Abdulla Hassan, the "Mad Mullah"; for during this time, which lasted some twenty years, tribal arrangements were completely dislocated; only the Mullah's adherents were able to frequent the south-eastern Haud, and there was considerable congestion in areas far enough away to appear safe, such for instance as Odweina, where one now finds large extents of dead bush, unquestionably due to over-grazing.

North-west of the Haud is a completely bare plain, at an average elevation of about 1500 m., with its northern point about 15 miles in British territory, and bounded on the west by the escarpment of the Harrawa valley and on the south by the hills behind Jijiga. It has no collective name, that of Marar assigned to it on existing maps belonging in reality to a water-point near Jijiga. A large proportion of the south-western half of this plain is under cultivation. North-west of this plain the hills start, at first as isolated peaks, or even masses, rising out of undulating country, well covered with bush and cultivation. Four of these peaks reach to over 1800 m. Then comes the broken country which forms the western end of the maritime mountains, the biggest element being the Libah-hele range. This terminates somewhat abruptly at its western end, where the Harirad gorge separates it from the striking mass of Gerigoan. The main part of this block of lithographic limestone has a remarkably smooth, tilted top, and for the greater part is surrounded by precipices. Except however for the western end of Libah-hele, the maritime mountains seem to consist in the main of two types: towards the west, rounded features with grass and sparse thorn bush and, on some of the higher parts, what is perhaps optimistically described as cedar forest—I should call it juniper scrub myself; towards the east, flat-topped hills of the type so common in Africa, showing erosion from a former even level, perhaps a sea-bed. Both types of course are much cut by ravines, some of which are not lacking in grandeur.

North-west of Gerigoan lie the tumbled masses of Marmar Gedle and Marmar Heir, the former a system of parallel ridges running north-west to south-east, the latter circular in plan, with a central peak. Both have in the past been rather zealously guarded as refuges by the Esa tribe. Marmar Gedle has now been mapped in full detail, but Marmar Heir is more complicated and we have a less thorough knowledge of it. The sheep and goat grazing in these mountains is particularly valuable. To the west of this lies the appalling desert through which the Chemin de Fer d'Ethiopie runs—completely bare and to a great extent covered with lava boulders, though parts of it are sandy. To the south, the broad Harrawa valley runs westwards through a region of dense thorn bush. North-east of Marmar Heir is a large plateau called Sa-wer, with a very level top and an escarpment all round.

Between Sa-wer and the sea is the Zeila Plain, a vast expanse of sand and grass, with several large watercourses running through it towards the coast. Though normally dry, after heavy rain in the mountains these are liable to cause a wide sea of mud that effectively bars the coastal motor-road from

Zeila to Berbera. Parts of this plain have a light sprinkling of thorn trees of one sort or another, but in general trees are restricted to the neighbourhood of the watercourses. On one of these watercourses, well out in the middle of the Plain, the Somaliland Government have installed a wind-pump and concrete troughs; a quaint sight in such surroundings, but needless to say it has more than justified itself. West of the Zeila plain is more broken country, which is in fact the edge of the mountain system of the French Somali Coast. Lava is the outstanding feature, particularly in the form of plateaux covered with boulders. The coastal half of this frontier zone is really one huge table, sloping eastwards from the Bura mountains, and, though much cut up by watercourses, nearly devoid of water. It is consequently little visited by the Somalis, and guides for it are extremely difficult to obtain. The coast-line between Zeila and Jibuti is low and shelving. Unfortunately my geological knowledge is nil, so that I cannot enter into any discussion on that score except in the very widest terms. The mountains are heavily faulted, and there can be no doubt of considerable volcanic activity in the past, particularly in what is now French territory. Beside that however about 15 miles west of Bulhar, on the coast, the mountain of Elmis has a well-preserved crater; while a few miles south of Beyu Anod there are a number of striking pinnacles that must be the plugs of a volcano the rest of which has been worn right away.

The Somali has been described not infrequently. I will therefore endeavour to mention only some of the less well-known points about him. But to put these in their proper setting, a certain amount of the general picture must be painted. The race, in the first place, is divided into the *Aji* or pure blood and the *Sab* or outcast. The latter consists of three tribes—Midgan, who are hunters and menials, and provide the sweepers for the European community; Tomal, who are the blacksmiths; and Yibir, a begging tribe who play an important part in Somali life, living largely by the survival of superstitious beliefs. In general, the Sab are scattered among the Aji, to whom they are subject. The Aji comprise Asha and some others mainly living in Italian Somaliland. There are two big branches of the Asha—Ishaak (which I should prefer to spell Isahaq) and Darod. The former essentially people the British Protectorate. The latter have two very big units in the Herti and the Ogaden and a number of smaller ones. The Herti occupy the coast from some distance east of Berbera fairly continuously all the way round to the Kenya frontier, though one element, the Dolbahanta, live inland, mainly in the eastern part of British territory. ***En passant*** I should like to quote the opinion of other Somali tribes about the Dolbahanta—"the children of a blind old man by a mad old woman."

West of the Dolbahanta are the Ishaak, and west of them are the Gadabursi, a tribe said to be a hybrid of Ishaak and probably Ogaden. They seem to be fairly generally unpopular, perhaps because they are to a considerable extent agricultural, whereas the true Somali is essentially a nomad. They are also not a little feared on account of the belief that they have a practice corresponding to that of werewolf, but with hyena instead of wolf. The Ogaden are south of the Dolbahanta and Ishaak. Until quite recent times they used to send big caravans through to Berbera and Bulhar, but those days are over and only individual Ogaden visit British territory now. To the west of the Gada-

1. Looking N.W. from the crest of the main ridge of Marmar Gedle

2. Broken country W. of the Zeila plain: the Mirmir range with the boundary in left foreground

3. Milmilagd, S. of Beyu Anod: remains of a volcanic plug

4. Esa dance

5. Bulale: part of the group of wells for camels

bursi are the Esa, a wild tribe with a tremendous reputation for fierceness. As their western neighbours are the still wilder Danakil, no doubt they need it, particularly as there is no love lost between the two. The origin of the Esa is not certain though they are recognized as Asha. Their country lies partly in British, partly in French, and partly in Ethiopian territory; a circumstance of which they naturally make the most. Indeed only once have the authorities astride the frontier co-operated in punitive measures, and I believe that the lesson will not be forgotten for a considerable time, for the operations lasted for between three and four months, and of all those "wanted" only one was not captured.

As I have already said, the Somali is essentially a nomad. Tribal areas are well enough recognized, but they overlap and sometimes side-step in the most puzzling way. In bad years of course a tribe may wander off into its neighbours' country, but it is generally arranged amicably. A Somali never marries a woman of his own section, and preferably not even of his own tribe. This may be due in part to a knowledge of the rudiments of eugenics, but there is no question that a very important reason is to obtain the right to visit the wife's family—in other words to secure additional grazing ground for his stock. The stock consists essentially of camels, whose milk is the main item of Somali food. The Somali camel is an excellent beast, willing and gentle, and quite a number are nowadays trained as riding animals. Except in the latter case, they require no rations and subsist entirely by grazing. In the western Ishaak and Gadabursi country there are a good many cattle, but elsewhere the rainfall is insufficient. Sheep and goats are everywhere. The sheep are a variety of the Persian fat-tailed species, and I believe that about 1,000,000 "Somali blackhead" skins are exported annually, and are much sought after by glovemakers. On the coast between Zeila and Jibuti, but nowhere else that I know of, the goats graze on top of the acacia trees and bushes. The Ishaak, Dolbahanta, and Ogaden also have ponies; but African horse sickness periodically takes a heavy toll of them. It is said for instance that during the operations against the Mad Mullah he lost 1,500 from that cause alone. Most water places consist of one or more wells or water-holes. But at a few there are a whole series of wells in the bed or on the banks of a watercourse, and the organization is then interesting. At Dagahbur individual wells have specific ownership but are used for all requirements, human and stock. At Bulale and I believe also at Dabawloq the wells are in groups—one for donkeys, one (the biggest group of course) for camels, one for sheep and goats, one for cattle, and another for humans. Inside each group there is individual ownership of particular wells. In this N.W. Ogaden–W. Ishaak area, the buckets used are wooden, shaped like and about the size of a 4·5-inch howitzer shell without a base, and these are thrown up from man to man from the bottom of the well to troughs at the top. It was fascinating to watch, for the movement is exceedingly graceful.

In his true native state the Somali leads a very hard life and his character is hard in consequence. He is tough and wiry, but far from robust, and the death-rate from tuberculosis is high. Like, I suppose, most nomads contact with civilization does not to my mind improve him. I at all events cordially disliked the sophisticated specimens near the coast, and very much preferred

the simpler types of the Esa and Ogaden, greatly averse though the former are to contact with the Government. Under strict discipline and good handling a lot can be done with them, whether as police, military, or merely as coolies—for economic circumstances have compelled them to manual labour. But they are quite useless as porters. Two anecdotes will serve to illustrate their quickness of temper—and various other characteristics. Two coolies who had been with the Ethiopian Section for nearly two years had an argument over the rations, in the course of which one suddenly drove his knife into the other's stomach—a fatal wound. On one occasion our Demarcation Party sent three runners for a considerable distance through the Haud; after doing 80 miles they had a rest which one of them was unwilling to end, whereas one of the other two urged a move. During a momentary absence of the third, the lazy one drew his knife and pursued his tormentor, finally succeeding in inflicting a severe wound in the back. The third man ran all the way to the Demarcation Camp for help, and Major Godfrey-Faussett, in the doctor's absence, set off in a six-wheeler with bandages, etc. On arrival he found the victim lying in the sand, breathing through his wound and the assailant looking after him to the best of his ability. Lavish bathing of the wound in distilled water (that proved to be the entire stock of liquid quinine) and bandaging that compelled breathing through more normal channels were followed by a bumpy return journey along the boundary, and on reaching camp the patient was so far recovered that he asked to be sent in to Burao, 100 miles away mainly through bush. He arrived there sitting up alongside the driver. After a very short time in hospital he was fit to attend the District Court for the case to be tried, and only a few weeks later was back at duty. The assailant, a healthy sturdy young fellow, retired to Berbera Prison where he died within six weeks without symptoms of any sort!

Somaliland used to be the great *shikar* resort for Aden. I think it was about twenty years ago, an epidemic of rinderpest occurred, and it was found necessary to make the Greater Kudu royal game. That protection was entirely effective and has now been relaxed. On the other hand Swayne's hartebeeste which used to be extremely plentiful on the plains north and east of Jijiga, seems to be nearly extinct; I have only heard of one being seen for certain in recent years. Lesser Kudu are numerous, as are Soemmering's gazelle, Pelzeln's and Speke's *dhero*, and *genenuk*. Klipspringer and *baira*, the latter peculiar to Somaliland, are by no means rare in the mountains, and that peculiar creature the *dibataq*, a gazelle with the horns of a reed-buck and a short, stiff, furry tail which is erected vertically when the animal is alarmed, is to be found all over the Haud, except in the west. Dikdik of several sorts abound. There are lion, leopard, and cheetah, and a good variety of vulpines. Of birds there are ostrich, francolin, and bush partridge, guinea fowl, both common and vulturine, an occasional duck or Egyptian goose, and we once met snipe in the south of the Haud. But it is markedly a country of bustards, greater and lesser, in a number of different varieties. Besides that, immense numbers of sand-grouse visit certain water centres. There was therefore no justification for the advice given to Major Godding—that it was no use his bringing out firearms, though he might find a fishing-rod useful!

The Anglo-Italian Somaliland boundary had been demarcated in 1929–

1930, the work being carried as far west as 47° E., 8° N. Our work therefore started from this point, but with the qualification from the Ethiopian Government that this is not necessarily the Anglo-Italo-Ethiopian trijunction point, since the Italo-Ethiopian boundary is still indeterminate. From here the boundary was to run in a straight line to Aranare (spelt Arran Arrhe in the Treaty). This however is an area of about 50 square miles, and the name is not particularly rare, for *aranar* is a very common variety of small thistle, much appreciated by camels. So we agreed to adopt 44° E., 9° N. instead. The boundary, by Treaty definition, should then run in a straight line to Moga Medir, a point which we had little difficulty in identifying as the rock nowadays called Jifu Meider. It is the most striking feature in this part of the country, consisting of a number of huge rocks wedged together in quite a remarkable manner. We then persuaded the Ethiopian Section to agree to abandon the straight line and to use the bed of the Tug Wajale, a long depression containing a number of important seasonal water-points, where it would be possible to exercise a certain amount of veterinary control on migrating stock. The westernmost corner of the boundary is defined in the Treaty as "the hill of Somadu." But there is no hill of this name, and it seemed evident to us from old documents that the most prominent feature of the neighbourhood, called Beyu Anod, was intended. A compromise was eventually found. The Treaty gave us little help as to how the line should run between Jifu Meider and this corner—which was just as well, as the ground was unknown. At the cost of much clambering we eventually selected what I feel sure is the best natural feature line through this stretch. Plate I shows for instance what a perfect line is afforded by the crest of the main ridge of Marmar Gedle. From Somadu towards the sea we were required to follow an old caravan track, passing through the lava country which appears to have been the route generally used forty or fifty years ago between Zeila and Harar in preference to an easier one a little farther east, on account of the water problem. Nowadays however the eastern route is customary.

The Anglo-Ethiopian Treaty merely defines the boundary of British Somaliland, without specifying the trijunction point at either end of the Ethiopian portion. This is understandable as regards the eastern end, since the Anglo-Ethiopian Treaty preceded the Italo-Ethiopian. The Anglo-Franco-Ethiopian trijunction point had to be deduced by a compromise between the three relative documents—the Anglo-French Agreement of 1888, the Franco-Ethiopian Convention of 1897, and the Anglo-Ethiopian Treaty of 1897. This necessitated determining the position of the Anglo-French boundary point on the coast, described in the Agreement as "opposite the wells of Hadou," a name that is unknown. Fortunately for us, the local authorities had agreed a year or two after signature of the Agreement to recognize a prominent palm-tree at La-waada as the point in question, and, though this tree has been dead for many years, we were able to locate its stump. For this part of our work we were joined by representatives of the French Government, and I would like to record that, though circumstances forced some extremely tiresome discussions on us, we made some very good and enduring friendships. Having settled the trijunction point, we selected a natural feature boundary back to Somadu, in place of the caravan track.

Our instructions required us to start demarcation work at the eastern end. So, after locating and marking the corner at 44° E., 9° N., both Sections sent their main parties to the boundary just south of Bohodle, an important centre in the days of the operations against the Mullah at the beginning of this century, where the ruins of our old two-storeyed stone fort are still visible. On the way there one passes at Kirit another relic of that period, a derelict steam engine that was installed for water-supply duties by the Expeditionary Force. Having located a point on the boundary, the two sections started demarcation in opposite directions, working to a detailed specification, the main features of which were: (*a*) a lane cleared of bush for 2 metres on either side of the line so that our motor vehicles could use it as a road. (*b*) boundary pillars so sited that from any point on the line one should be visible in each direction, the interval between pillars in no case exceeding 2 kilometres. The Tug Wajale presented rather a problem. Its channel, though definite, is small and in many places could easily be passed by any one not on the look-out for it; and we were afraid of doing anything that might tend to reduce its water-holding capacity. The channel was cleared of bushes, and small survey marks were erected in pairs on either side. In addition, to serve as warning of its proximity as well as to facilitate frontier patrolling, a motorable track was made along each bank. I am afraid it remains to be seen whether this will provide a really satisfactory solution; we could not think of a better. In the undulating country between Jifu Meider and the maritime mountains, the boundary crosses a certain amount of cultivation. The first attempt to guarantee the preservation of the line was made by the Ethiopian Section, and took the form of laying a bed of stone. Needless to say the transport involved proved prohibitive, and another scheme was evolved which has stood the rains in a way I did not expect. This consists of pairs of ditches, the bank between them being the boundary; the ditches are in short lengths, to reduce the danger of their becoming watercourses.

We met another problem when we reached the lava country. After a good deal of head-scratching and some trial work, we decided to "scrape" a path through the boulders and gravel, astride the line. I am confident that this gives a permanent result; for paths are rare and bad, and this will undoubtedly be used by men and animals; while its straight line and regular edges declare it to be artificial. The majority of our boundary pillars were dry stone cairns, though some were cement concrete. Altogether there were 1,166, of which 33 were masonry; and to this must be added 54 pairs of cement survey marks along the Tug Wajale. Across the central part of the Haud stone was a difficulty. Special reconnaissances were necessary, and our two six-wheeled lorries were kept fully occupied on this duty alone, the distance to the outcrops being sometimes as much as 10 or 12 miles.

The tribes displayed a good deal of disapproval of the boundary, for they feared that it implied restrictions on their grazing and would not be persuaded to the contrary. Consequently a good deal of pillar destruction occurred. The Somaliland Government imposed—and collected—a considerable total in fines and rebuilt the pillars for whose maintenance they are responsible, and the trouble appears to have been checked. The Ethiopian Government had similar measures under consideration, but other and greater preoccupa-

tions have so far prevented their application. The rates of progress of demarcation realized by the British Section were from 1300 to 1750 metres a day across the Haud; on the average just about 1000 metres a day between Sau and Somadu; and 1600 metres a day between Somadu and the Anglo-Franco-Ethiopian trijunction point. In the case of this last stretch however all survey work had already been done, so that all effort was concentrated on demarcation. These figures afford complete testimony to the excellent organization and drive of the officers in charge of our demarcation party—Major Godfrey-Faussett, and his successor, Captain Taylor. But one must not fail to recognize that it also shows the energy displayed by our three survey N.C.O.'s and by the coolies. We completed demarcation of the boundary at the end of June 1934, after which we were occupied till the end of February 1935 with completing our records, drafting the Boundary Agreement and studying the trans-frontier grazing problem. Mr. Curle, Captain Taylor, and myself then went up to Addis Ababa, where the Agreement was signed on March 28; and so back to this country.

In the first part of our work in the Haud water was an unceasing pre-occupation for the Demarcation Party. Every available *barramil*—the Somali name for the 12½-gallon water-tank used for camel transport—was handed over to them; but the camels took five and six days for the return journey, and it was never possible to establish any reserve of water at all. During this period it was usual for the last drop to have been issued by the time the daily convoy arrived. Finally we filled a number of 4-gallon petrol cans with water, soldered them up, and sent them down. Fortunately they were never actually required. I say fortunately, for we found that odd bits of cotton waste and rags had been included with the water. As the party got nearer to Hargeisa the situation eased very greatly. All through the latter part of our work in the mountainous country water was never a real source of anxiety, as it was never more than one day away for the camels, and generally only a matter of hours. In a number of watercourses there are what the Somali calls *durdur*, that is to say stretches of running water that die out and perhaps appear again a little farther on. The strength of flow of course depends on the season, and some *durdur* are liable to cease completely in a dry season; but even so one can generally count on finding water in a *durdur* stretch with very little digging. Thanks to the geological faults, there are quite a number of springs, some of which are mineralized and hot.

All across the Haud our work was controlled by astronomical methods, for the flat, bush-covered nature of the country made triangulation impracticable. Once out of the bush however triangulation came into its own, right through to the coast. It is not often nowadays that one is required to measure a base for triangulation. A good deal of study was therefore needed for both siting and procedure; Brigadier Jack's admirable report on his work on the western frontier of Uganda eventually told us what to do and why. By a curious coincidence, our base measurement gear was also that used by him in 1908. It had been done up for us, but I personally should hardly have described the "frictionless" pulleys in those terms. I understand that the age and behaviour of these invar tapes are a matter of some interest, but I have not been able to examine the point yet. Our theodolites were all British, from Messrs. Cooke

Troughton and Simms—an 8-inch micrometer, against which we had a number of criticisms, but which nevertheless produced most satisfactory answers; two of the new Tavistock model, which were used for the triangulation and all general work with very remarkable results (though we had trouble in one respect with one of them, I cannot sufficiently congratulate the makers on the production of this very delightful little instrument) and an ordinary 5-inch micrometer, which was kept in reserve and hardly ever used. Topography for the map of the boundary was obtained by air survey methods, and for this purpose a special Air Survey Flight, under Flight-Lieutenant Cator, was detached from Aden. The particular point of interest in this case was that photography was carried out ahead of the ground work. This fact produced a crop of problems of its own in the navigational field, particularly during the first few months when working over the Haud. Lack of meteorological data was also a difficulty, records being naturally available only for the stations. Photography actually started at the end of January 1932, but suffered from interference from cloud (frequently in the form of that bug-bear of survey photography, high detached cloud) until early September. Delay had also been experienced on account of sickness and one or two misfortunes such as crashes, though I do not wish to suggest that the Flight had anything but a thoroughly good record in that respect. September, October, and November saw rapid progress; but, with the job all but completed, the weather broke up completely about the middle of December. Little was achieved during January and February, and still less in March; at the end of which month the Flight was withdrawn to Aden. The last few runs of photography were made later in 1933 by aircraft specially sent over from Aden. Some idea of the magnitude of the task may be gained from the resulting total of about five thousand exposures for mapping: though it must be admitted that, owing to the photography being done in advance of the ground work, and indeed as far as the western part is concerned, in advance even of the political decisions, a much greater area had to be covered than the narrow band 8 kilometres wide required for the boundary map. This figure also includes an 8-kilometre belt along the Anglo-French Somali frontier, which we surveyed but did not demarcate.

The performance of the Air Survey Flight calls for comment. Even allowing for Flight-Lieutenant Cator's very considerable experience, the standard of the photography was first class and that of the navigation as near perfection as is, I should say, possible. Having the photographs taken ahead of the ground work was, as you may imagine, of the very greatest help to the surveyors. Not only did it provide a most valuable reconnaissance, but it made matters so easy, working on the photographs themselves, to provide all the data required for making the map. With the practice they got, Captain Taylor in particular and Corporal Griffiths to a lesser degree were able to extract almost any information needed from the photographs, one very useful item towards locating themselves being the age of a thorn *zariba*.

I have already mentioned that the Treaty accords trans-frontier grazing rights; and, besides demarcation of the frontier, the Commission was required to submit a joint report on the extent of the individual grazing grounds on either side of the frontier. We therefore made a reconnaissance map on 1/125,000 scale almost wherever we went. In the west this was controlled by

our triangulation, in the east by the boundary demarcation and a number of astronomical points. In connection with this work I cannot refrain from mentioning the very fine performance of Captain Taylor, who in one particular period of sixty-two days traversed 1435 miles, 153 of them on foot, the remainder by six-wheeler, with an additional 939 miles travelling but not traversing. During this same period Corporal Griffiths, in addition to helping me with astronomical and various other duties, traversed 160 miles on foot and 626 by six-wheeler. The mapping of Somaliland is still very incomplete. The Expeditionary Force at the beginning of this century and the Anglo-Italian Boundary Commission in 1929–30 have more or less completed a large block. The work of Captain H. G. C. Swayne, R.E., and Lieutenant E. J. E. Swayne, Bengal Infantry, between 1886 and 1892 covered a big area in the west; while in 1903–04 Major S. L. Craster, R.E., ran a railway reconnaissance from Berbera to Harar. The rest of the map is compiled from route reports and "travellers' tales," and is highly unreliable. Tracks are shown where they do not—or at least do not now—exist, under the wrong names, and leading to the wrong places.

We had a certain amount of difficulty in establishing a datum point on the coast for our heights. The behaviour of the tides between Zeila and Bab el Mandeb is somewhat eccentric, and we endeavoured first of all to connect on to some recent French hydrographical triangulation round Jibuti. But I regret to say—or should I be glad to say?—that we hit on an unexplained error in that work, which put our point on the shore about 25 metres below sea-level. So we had to fall back on the obvious and level between high and low water-mark on several days. Place-names were a heavy task. We had 1500 of them. For ordinary British purposes spelling was required under the R.G.S. II System; but the Commission's official language was French and a French version of the names was therefore required. This has forced on us the preparation of a gazetteer with the equivalent spellings. In some areas it was very difficult to ascertain place-names, different guides having quite different ideas. Another trouble arose from the frequently apparent indifference of the Somali in the matter of choice of vowels; in general we worked by the meaning and, for the sake of consistency, ignored minor variations of pronunciation. The Somali language belongs to the Arabic group, though quite distinct from and with a greater variety of sounds than Arabic. The R.G.S. II System consequently is easily applied.

In matters of health we had our share of bad luck. Early in 1933 two of our officers developed Malta fever and we were fortunate in being able to evacuate them by air to Aden. Both were extremely ill and indeed nearly died. Major Twigg has fully recovered; but Squadron-Leader Lindop, after more than a year in hospital and convalescence, has been obliged to retire from the Service. Then in June 1933 Mr. Plowman developed acute nephritis and again the Air Force came to our rescue and flew him to Aden. In February 1934 the Senior French representative, M. Roussan, had sinus trouble and had to be evacuated. Early in March 1934 Herr Beitz, the German *chef technique* of the Ethiopian Section was ambushed and killed by a party of Esa tribesmen. A week later Lij Zaude Balaine, Assistant Ethiopian Commissioner, had to be evacuated to Addis Ababa with acute appendicitis. Ato Lorenzo Taezaz, who

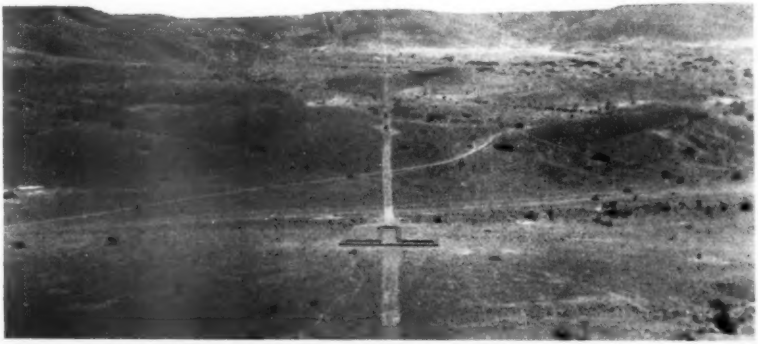
replaced him, developed pneumonia in June. We had only three cases of malaria among the Europeans of the British Section; but one of these, Corporal Marshall, who must have been infected only a day or so before he left us, died twenty-four hours after landing in England. Among the native staff we had one epidemic of malaria and a variety of other diseases, but relapsing fever was the favourite and could always be relied upon to appear after a short spell at any of the towns. But when all is said and done our casualties attributable to climate were remarkably few, considering that they were spread over a period of thirty-eight months all spent under canvas, without a break. Local leave offered little in the way of attraction—least of all to the N.C.O.'s—it would have been too much of a busman's holiday. So, besides encouraging all forms of outside interests, we relied on change of occupation wherever possible, for maintaining moral and preventing staleness.

It is difficult to describe the climate briefly, as there are such contrasts. The coast is delightful from November to February; but appalling between May and September during the *kharif* season. The wind then seldom eases and carries vast quantities of sand, while the shade temperature ranges round about 108° F., and there is little relief at night. When demarcation reached the Anglo-Franco-Ethiopian trijunction point at the end of June 1934, thinking to afford a welcome change from the monotony of demarcation, I arranged with Captain Taylor for the party to return to headquarters at Borama, traversing for our reconnaissance map on the way. We had neither of us realized in the least the severity of conditions in the Zeila Plain in early July. There was this unending sand-laden wind; visibility never exceeded 400 yards; the temperature I have already mentioned; and the atmosphere was so dry that mouth and throat became so parched that no amount of liquid made any effect—one inevitably reflects on the wisdom of the Touareg veil in the Sahara. Fortunately they reached the mountains in a week and were able to restore their moral and health in the fresher atmosphere and green surroundings due to recent rains. In the interior—I am speaking of the boundary zone—we were at altitudes varying between 600 m. at the eastern end and 1500 m. in the Borama area. Our base camp was at Borama for just over two years. There the air is good and the scenery pleasant, and the average annual rainfall is about 20 inches. Round about Christmas the night temperature falls to very near freezing point. The coldest place we met was Jijiga, where in early January 1935 water in *chaguls* hanging outside our tents froze at night —to the amazement of many of our staff who had never seen ice before.

During the winter of 1932–33 Mr. Farquharson, Geologist to the Somaliland Government, was attached to the Commission and made two reconnaissances in the mountainous country to be crossed by the boundary. His reports were far too technical for my comprehension, but may be summarized by saying that he had a very interesting time but found nothing of any value. In the botanical field Major Godfrey-Faussett collected a number of specimens of grasses during 1932. In September of that year the Director of Kew Gardens sent out Mr. Gillett, who, based on the Commission, worked a considerable area round Hargeisa and Borama before going on to Harar in the middle of February. After that, Major Godding carried on the work. Captain Taylor had developed an interest in reptiles when serving with the Anglo-

6. Old caravan road, boundary between "the hill of Somadu" and Habaswein

7. Demarcation across cultivation at Dababur, near Borama



8. The boundary scraped through lava boulders and gravel, between Somadu and Dulusbo. The T-shaped enclosure is an aeroplane identification mark

9. Gerigoan, east end, a detached mass opposite western end of Libah-hele range

Italian Boundary Commission. Before coming out again he studied the subject at the Natural History Museum, to which he has now sent a collection of about two thousand specimens. Mr. Curle made a collection of ethnological specimens, with special relation to the Esa tribe, for the British Museum. Burton, in his 'First Footsteps in East Africa,' describes a ruined town, Abasa, which he visited in 1854. Several others have been known for some time past, but no knowledge of their origin was forthcoming. The Somalis can contribute nothing. Mr. Curle, who is the son of the well-known Scottish archaeologist, made a series of investigations, assisted by Captain Taylor, at no fewer than fourteen sites within reach of Borama, and their finds have been sent to the British Museum. These included coins which have been identified as of Kait Bey, Sultan of Egypt 1467–97, and this leads one to the conclusion that these towns probably belong to the period of the Adal Empire. In the western part of the country, by which I mean the mountains and the lava area, graves are often quite elaborate, the mound of the grave itself being decorated with bands of coloured pebbles; a neat low wall, about 18 inches high, surrounds a clean-swept space, generally more or less rectangular. Miniature alcoves in this wall, as often as not covered with a flat stone, each represent a hut, that is to say a wife. We met a variety of shapes, some possibly of some age and suggesting pre-Islamic origins or at least influences. Side by side with these one finds surface burials, a hollow cairn being raised over the body. In the neighbourhood of the French frontier we met a number of enclosures of unknown age. The Somali knows nothing about them. One is tempted to describe them as halting places for caravans, but for the fact that some of them are not near tracks.

The British Section was a large party. At its maximum it included besides myself:

Major B. T. Godfrey-Faussett, M.C., R.E.
Mr. C. H. F. Plowman, O.B.E., Political Officer.
Squadron-Leader V. S. E. Lindop, R.A.F., Air Liaison Officer.
Major T. H. Twigg, R.A.M.C., Medical Officer.
Captain R. H. R. Taylor, R.A.
Mr. R. A. Farquharson, Geologist.
Mr. J. B. Gillett, Botanist.
Mechanicist Staff-Sergeant D. G. P. Shelley, R.A.S.C., in charge of our motor transport.
Lance-Sergeant E. V. Elkins, Royal Corps of Signals, wireless, clerical, and store duties.
Corporal J. B. Marshall, R.E.
Corporal R. Griffiths, R.E.
Sapper S. L. Terry, R.E.

Mr. Plowman was replaced by Mr. A. T. Curle; Major Twigg by Major H. C. Godding, M.C., R.A.M.C.; and Staff-Sergeant Shelley by Corporal A. V. Wells, R.A.F. The Air Survey Flight, commanded by Flight-Lieutenant F. G. Cator, R.A.F., consisted of twenty senior N.C.O.'s and other ranks. Our native staff varied according to the work in hand, but on the average totalled round about 100 to 120. We were provided with an escort by the

Somaliland Camel Corps, and for part of the time by the Somaliland Police, the total strength varying according to circumstances.

The Ethiopian Section was headed by Fitaurari Tasama Bante, one of the Emperor's more immediate following, who had been in charge of H.R.H. the Duke of Gloucester's shooting trip to the Arusi early in 1931. I have nothing but the pleasantest memories of my dealings with this typical Ethiopian gentleman of the intelligent "old school," though I acutely felt the lack of a language common to us both. He had as assistant Lij Zaude Balaine, a young man who had spent some twelve years studying engineering in France; and also for the last year of our work Ato Lorenzo Taezaz, who had the advantage of a first-class legal training at Montpellier University and speaks most fluent French and Italian. Their technical staff were all Europeans of varying nationalities. Starting with two Frenchmen, two Dutchmen, and one Hungarian, they later had two Germans, one Czecho-Slovak, and one Bulgar. In addition they had two Syrians in charge of their mechanical transport. Our relations with the Ethiopian Section, and indeed with the Ethiopian authorities in general, were throughout of the best. To venture into the fringe of the political field, the essence of the work of a boundary commission is the improvement of frontier relations. In this case it is useless to deny that at the start there was considerable room for improvement, due primarily to ignorance or out-of-date ideas on both sides. I cannot say whether we or the Ethiopian Section worked the harder on this aspect; but if we succeeded in having as good an effect on the Ethiopian side as Fitaurari Tasama and his staff achieved on the British, we have every reason to be satisfied. We certainly received a great many kindnesses and a lot of help from the Emperor and all grades of Ethiopian officialdom with whom we came in contact.

In Somaliland we were of course very heavily indebted to the Governor, Sir Arthur Lawrance, for many acts of hospitality and personal kindness, in addition to our excellent official relations. I will not attempt the invidious task of mentioning individually the heads of departments, administrative officers, and officers of the Somaliland Camel Corps, from whom we received so much help, often at the cost of considerable additional work to themselves, and so much hospitality. Our visit to Addis Ababa was spent at the Legation and proved a most delightful contrast to the preceding years, as I am sure those who know Sir Sidney and Lady Barton will readily imagine. Nothing could have been more helpful than the attitude of the Royal Air Force at Aden. They lent us stores, notably a wireless transmitting set which proved of untold value; they met all sorts of needs either from stock or by local purchase, thereby saving us the delay and freight charges involved in ordering from Home; I have already said how they carried our hospital cases to Aden; and there was also really excellent co-operation in connection with the air survey work. I simply cannot express my gratitude to Air Commodore O. T. Boyd, O.B.E., M.C., A.F.C., and his successor, Air Commodore C. F. A. Portal, D.S.O., M.C., and to their officers for the way in which they eased our path, particularly since it was all done from kindness of heart—I had no call on their services apart from the photography.

DISCUSSION

Before the paper the PRESIDENT (Major-General Sir PERCY COX) said: The paper to be read to-night is "The British Somaliland-Ethiopian Boundary" by Lieut.-Colonel E. H. M. Clifford. I may not have an opportunity later, so I would like to let you know now, in case you missed it in the papers, that Colonel Clifford received the C.B.E. in the last Honours List for his work on this important Boundary Commission.

The task of the Commission took over three years, from 8 January 1932 to March 1935. I do not suppose we shall hear much about that aspect of it during the course of the paper but the work was carried out in what I know from experience to be a punishing climate. Nevertheless the performance was a first-class one. We shall hear more regarding its accomplishment from those who will join in the discussion. I now ask Colonel Clifford to read his paper.

Colonel Clifford then read the paper printed above, and a discussion followed.

The PRESIDENT: We have the great pleasure and honour of having with us this evening H.E. Azaj Worqueh Martin, the Minister of His Imperial Majesty the Emperor of Abyssinia. He has kindly consented to address a few words to us.

I have His Excellency's permission to tell you an extraordinarily interesting fact—that His Excellency was rescued as a baby from the battlefield at Magdala in 1867 by a British officer, Colonel Chamberlain. That knowledge will, I am sure, add greatly to your interest in listening to him this evening.

H.E. THE ETHIOPIAN MINISTER: Mr. President, My Lords, Ladies and Gentlemen—I did not understand earlier that I should be called upon to address you and I fear I am not very good at making extempore speeches, but since I have been ordered to say a few words I will obey.

It has been a great pleasure to the Ethiopian Government to have an opportunity of completing the boundary between Ethiopia and British Somaliland. There was of course no real necessity for it, because so long as people are really kindly and justly inclined there is no difficulty. However it is always wise to make sure!

The Commission has been very well conducted and its work has been so eminently well done and with such tact that there has been no difficulty whatsoever. That is very satisfactory, as when in other cases an effort has been made to have the boundary demarcated there has always been some difficulty. We will suppose there is some hidden reason for it.

It has been a great pleasure to me to hear Colonel Clifford describe the work done by the British Somaliland-Ethiopian Boundary Commission. I am glad he found the members of the Ethiopian Section reasonable, good, and satisfactory. At any rate, they did not give him any trouble.

One of the results of the Commission has been, as I know, the bringing about of a feeling of friendliness and confidence towards the British. When I first went to Ethiopia I found people there rather afraid of the British; in fact, they told me they did not want to have me even, because they suspected me to be a British spy. I tried to persuade them that there was no reason to fear the British; that they were nice, although they did not talk like some diplomatic folk, and that they were always reliable. Now working so long with the Boundary Commission has proved to them that the British were not really as dangerous as they were painted. I am very grateful to Colonel Clifford for complimenting the Ethiopian Section of the Boundary Commission and I hope that you are now satisfied that the Ethiopians are not quite as savage as they are painted by some.

The PRESIDENT: We should like to hear Major Cheesman, one of the Fellows of the Society who knows Ethiopia well and recently read a paper to us on Lake Tana and its islands.

Major R. E. CHEESMAN: There is very little of the boundary of which I can speak from personal experience because I only saw the far end of it near the Red Sea. I went out through Jibuti to Zeila. The road from Zeila to Jibuti crosses the boundary. At the point where the frontier joins the Red Sea there is what might be described as a Lido, and there we found Colonel and Mrs. Clifford at the Boundary Commission camp. It was very hot. On one side were miles and miles of sand and on the other side there were miles and miles of sea and little else.

I can appreciate from what Colonel Clifford has told us and from what I already knew that one of his greatest problems was to demarcate a line in an unmapped country, or rather an imperfectly mapped country, which is worse than an unmapped one because when there are wells dotted about over a map as a result of hearsay and travellers' tales, it is very difficult to shift them. Colonel Clifford had not only to deal with that sort of problem but he had, I can assure you, a very difficult tribal problem to cope with, because these nomads feel the country is theirs. When a boundary is being visualized or suggested by people sitting a long way away from the country involved it is very easy for them, with a map in front of them, to put a string across from one place to another, but that means that some day some unfortunate man has to find that line on the ground. That unfortunate man in this case was Colonel Clifford who had to demarcate the boundary.

I do not know a great deal about the tribes there, but I know they are very savage; they do almost anything but eat you. They are not cannibals, but they have to be carefully and tactfully handled. Half-breed Arab and African is, I think, the origin of the nomads in that part of the world. It speaks very well for Colonel Clifford's handling of them that everything connected with the tribes went through without any trouble whatever. I congratulate Colonel Clifford very much on the work he has done. It is a very long boundary.

The PRESIDENT: Mr. Beeby Thompson was in Abyssinia for a considerable period as the Adviser to the Ethiopian Government in connection with water problems.

Mr. BEEBY THOMPSON: It has recently been my privilege and pleasure to pay a second official visit to British Somaliland, and I can assure Colonel Clifford that in some of those places where he suffered great discomfort owing to lack of water, he would now find abundance of good supply. During a sojourn of several months in the country I was able to satisfy myself that potable water in considerable quantities is obtainable in many of the areas to which Colonel Clifford has referred during the course of the paper. He and others interested in Somaliland may be pleased to hear that already a large supply of water has been located and at Burao a piped system of distribution completed both for the military and civil lines. Following detailed investigations it was found possible to arrange a scheme for a pure water supply for the town of Zeila, the Colonial Development Fund having generously advanced the money with which to carry out an orderly scheme of distribution there, so that in the course of a few months Zeila itself will have a piped system into the town.

At Hargeisa pumps are now in use and there will soon be a piped system; and at Tug Wajale, where Colonel Clifford had great difficulty in getting good regular supplies of water, a first-class source has been found by boring and several wells have been completed, a windmill is working, and a satisfactory supply is assured for the local pastoralists who flock to this fertile valley.

Colonel Clifford will no doubt be amused to hear that the boundary posts, though doubtless very valuable in preventing disputes between Ethiopia and Great Britain, serve the further purpose of affording much relief to irritated cattle. In this treeless country full of insect pests there is nothing against which the cattle can rub their itching bodies, and the distressed animals struggle for the right of using the masonry boundary pillars.

It was a welcome surprise to discover that a large part of the Haud, which was believed to be waterless, is likely to yield important supplies of subsoil water. The few existing wells yield very impure and polluted surface water, but with the aid of skilful technique and mechanical devices it will be possible to develop first-class water centres at many points, thereby diminishing the congestion of men and animals at a few places and lessening the evil of overgrazing.

A piped service has also been provided for Ideikh and a good source of water has been developed on the arid plains between Zeila and the mountains.

The PRESIDENT: I think we must call upon a surveyor to make some observations: Colonel Crosthwait.

Colonel H. L. CROSTHWAIT: What has struck me most in connection with the British Somaliland-Ethiopian Boundary Commission is the immense advance which has taken place in the technique of boundary demarcation, especially the instruments. The Commission had the use of the prismatic astrolabe which, when it is fitted to the theodolite according to Mr. Reeves' plan, is a most useful instrument. Then there is wireless, which was not in use when I was demarcating boundaries, and of course there are vastly improved means of transport, and above all there is that new aid, aerial photography.

Every boundary should be photographed from the air. That method has great advantages, because even if the boundary has been cleared through jungle and it grows over, for years afterwards the boundary can still be seen when photographed again from the air. As we know, centuries-old markings on the ground have been discovered through the agency of aerial photography. I suppose the photographs of the boundary are now attached to the protocol in the same way as the maps are.

On the boundary on which I was engaged there were no local political difficulties simply because there were no inhabitants—a great advantage to those who have to demarcate boundaries. Instead of using masonry pillars, as Colonel Clifford did, we used iron pillars which were brought out in sections and erected on the spot. That again shows there were no inhabitants. Iron would probably quickly disappear in the country Colonel Clifford had to deal with.

I do not know anything about Somaliland because I have only been to Berbera for a short time, but I have been very much interested in the lecture and should like to thank Colonel Clifford for what he has told us.

The PRESIDENT: I should be very glad if Sir Arthur Hill, the Director of the Royal Gardens at Kew, would make a few observations on the botanical collection made by the Commission.

Sir ARTHUR HILL: By a happy chance a good many years ago when Colonel Clifford was having tea with me I remarked how unfortunate it was that when the War Office or some other Government Department was sending commissions or expeditions to interesting parts of the world there was never an opportunity of attaching a botanist to such commissions. Two or three years afterwards I was astonished to receive a letter from the War Office saying that they understood I was anxious to attach a botanist to the British-Italian Somaliland Boundary Commission, and asking me to call at a certain room at the War Office. There I found Colonel Clifford, and realized that my chance remark had borne fruit. Thanks to him, and thanks also to the grant made to Kew for

botanical research work by the Empire Marketing Board, I was able to depute Mr. C. L. Collenette as Botanist to the first Boundary Commission and Mr. J. Gillett as Botanist to the recent Somaliland-Ethiopian Boundary Commission.

A great many interesting plants—some sixteen hundred specimens—were brought back by Mr. Gillett together with valuable notes on the vegetation. Since Mr. Gillett's return, Major Godding has most kindly carried on the botanical work and has sent about three hundred specimens to Kew, all of which have been of value.

The main interest of the various collections has been that of extending our knowledge of the Somaliland-Ethiopian flora and linking it up with other parts of Africa. As an example I may mention that the Tree Heath, *Erica arborea*, was found above 9000 feet. This is the heath which grows also on the mountains of Kenya and Uganda. Several useful plants were found between 5000 and 6000 feet, including the Box (*Buxus Hildebrandtii*), a very valuable timber tree, and the juniper (*J. procera*), to which Colonel Clifford alluded, which also yields a valuable timber suitable, by the way, for making "cedar" pencils. This also occurs on the mountains as far south as Nyasaland. Both those would be well worth planting and developing in the higher regions.

The value of attaching a botanist to the British Somaliland-Ethiopian Boundary Commission has been shown by what we have learnt about the ecology of the region in connection with the geological features. Only a few novelties have been added to our collections, because the Italian botanist Chiovenda had already explored the country and found many new species, and so forestalled us. Nevertheless the attachment of botanists to the two Commissions has been well worth while from the botanical point of view, and I think you will agree how useful a body was the Empire Marketing Board and how wise it was in allocating funds to Kew for such purposes.

I must not fail to say that it was entirely due to the great kindness and assistance afforded by Colonel Clifford that both Mr. Collenette and Mr. Gillett were able to pursue their botanical studies so successfully, and to him and to all who were equally kind and helpful I should like to offer my best thanks.

The PRESIDENT: The hour is too late for me to invite others to address us, and I must close the evening's proceedings.

I would like to mention that in the early '90's my wife and I spent four years on the Somaliland coast, and I am sure my wife would like to compare notes with Mrs. Clifford as to the water supply at Zeila. We were strictly rationed with water from some wells called Takusha, but the ration came to us looking like pea-soup; and we had to put it through earthenware strainers before it was possible to drink it. We are the more glad to hear from Mr. Beeby Thompson how conditions have changed during the last four years, though indeed they have changed for the worse in one way, namely that much of the game has apparently disappeared. When I was in Somaliland the Marar plain was alive with hartebeeste. I am told that now hardly one remains.

I thank the lecturer very much for his valuable and efficient lecture. It will be of great importance to the Society to have this record of a fine piece of frontier delimitation. Although he has said little about it, I think we have realized from the casualties of which Colonel Clifford spoke towards the end of the paper what a trying time the Commission must have had on many occasions, especially during the hot weather. They lived in camp without any break practically for three full years and came through extraordinarily well. Let us congratulate Colonel Clifford on coming home as fit as he seems to be. I ask you to join me in expressing our high appreciation of his paper.

Mr. H. W. PARKER, of the Natural History Museum, also sent in the following remarks as a contribution to the discussion: As Colonel Clifford has mentioned, Captain Taylor became interested in reptiles whilst serving with the Anglo-Italian Boundary Commission in 1929–1930, and sent back several hundreds of specimens. These first collections came as a great surprise to us, for although we realized that our knowledge of the Somali fauna was not complete, we did not realize how very ignorant we really were. In all, representatives of close on a hundred species were obtained, of which fourteen or fifteen are new to science. In these days this is a very high proportion indeed, especially when the country collected in is part of such a zoologically well-known continent as Africa. But though the discovery of new species is an achievement in itself, it is by no means a fair criterion of the value of a collection. It is only by the collection of large series, showing the total amount of individual variation in any one locality, by collections made at different seasons to discover the nature and amount of the seasonal variations, by series taken in different localities to show geographical variation, by observations of habits, habitats, and so on, that we can ever find out what animals live in a country or amass the information necessary to elucidate their geographical, genetical, and ecological relationships. Captain Taylor's collections and observations in the field have already done much. Many of the so-called species previously reported from Somaliland we now know to have been based on aberrant individuals or on seasonal variants; in other instances, with the new material before us, it has become clear that the Somaliland animals are different from those found elsewhere and are in fact racially distinct.

The new knowledge makes it clear that the Somali Peninsula is, as it were, a faunal island, characterized by a very high proportion of endemic species and races. An analysis of its composition shows that it is composed of three elements. First there is a very small group of widely distributed, hardy African species, which seems to be able to exist under any of the climatic conditions which occur in the whole continent. Then there is a larger group (about a third of the total) of what may be called Eremian species: that is to say, inhabitants of the Sahara-Arabian Desert belt. The remainder, more than half, are found only in the Savannah provinces of East Africa south of about 10 degrees north. None of the first two groups show any change in Somaliland, but many of the southern forms are modified as distinct races, and most of the indigenous Somali species are allied to forms found in this southern region. This suggests, very strongly, that the principal factor in the production of the peculiar Somali fauna has been the desiccation of the country. The Ethiopian mountains must form a very effective barrier to the free movement of terrestrial animals, and as a result there are only two corridors open for migration into Somaliland. Those reptiles which have entered from the north-west, from the dry Sahara, have undergone no change, but those entering from the south, from a relatively well-watered area, have become very much modified. And since there is some evidence that the present aridity is very recent indeed, the corollary is that species-formation in that area must have been going on very rapidly.

That, very briefly and roughly, is the kind of work Captain Taylor has been doing by his hobby. Much still remains to be done, and the material he has collected recently will doubtless furnish critical evidence on many debatable points and fill many gaps in our knowledge of a comparatively little-known group of animals.

ORDNANCE SURVEY MAPS: *Discussion, with special reference to the Grid System, at the Afternoon Meeting of the Society, 9 December 1935*

IN opening the discussion the PRESIDENT (Major-General Sir PERCY COX) said: The subject is "Discussion of Ordnance Survey Maps." As regards the Ordnance Survey we, as a nation, ought to be justly proud. No country in the world has so wide a range of maps of different scales or anything on so large a scale as the sheet popularly known as the 25-inch map. The scale of that map, 1/2500, is so large that we do not have it in our map collection, for geographers do not use it; but it is the fundamental map of the Ordnance Survey and indispensable to all who own or are concerned with real estate in this country.

Again, outside this country little use is made of the system of graded or layer colouring for maps to show the relief of the ground, nor has there been any apparent reflection in map design, except in our own Ordnance Survey, of the great and increasing interest taken in the style of lettering used on maps. The Fifth Edition of the 1-inch map is a shining example of beautiful lettering. The Ordnance Survey are continually endeavouring to improve their maps to meet and, indeed, to anticipate, public requirements.

Directly after the war there began to be a demand by the public, Government departments, and county and municipal authorities for Ordnance maps for a number of purposes. Those demands, necessitating increased issues, came at a time when, owing to the need for national economy the Government had to reduce rather than increase the allowances budgeted for some of the departments, and the Ordnance Survey was one of them. Town-planning, road development, power schemes, water supply inquiries, land valuations, redevelopment of distressed areas or areas left derelict after they have been ruined by industrial development—for all these purposes maps were demanded which, to serve their purpose properly, must be strictly up to date. In fact, never has the face of the country changed so fast, at any rate since the construction of the main roads and railways in the first half of the nineteenth century.

As you probably know, the various aspects of the work of the Ordnance Survey are now under review and consideration by a Departmental Committee appointed by the Minister of Agriculture and Fisheries under the chairmanship of Sir John Davidson. The recommendations of that Committee will have a profound influence on the future of national surveys. This juncture therefore seemed to the Council of this Society to be an appropriate one for discussion of some of those aspects which most concern us. The subject is so large that we cannot possibly cover more than a limited part of it this afternoon. As a beginning, the Director-General of the Ordnance Survey, Brigadier MacLeod, has been invited to make a statement explanatory of some of the problems that the personnel of his department are now dealing with. One of those problems which is of vital importance is the vexed question of the measure of the national grid and its bearing on the relationship of our maps to maps of international interest.

As you know, the decimalization of British measures of all sorts has for some time been ventilated and advocated, but the British public have been up to

the present consistently obdurate. They do not like to think of our measures of weight and measures of distance being altered. It is an important question and there are, as usual, two sides to it; but Brigadier MacLeod will, I expect, propound some arguments which may influence the attitude of the British public. I ask him now to open the discussion.

Brigadier M. N. MacLeod (Director-General, Ordnance Survey): The 1/2500 Ordnance Survey of Great Britain is a series of detached county surveys rather than a national survey, for it is projected upon more than forty different meridians. This "county" arrangement has proved a source of much inconvenience and no little extra expense, but the Department has always had its hands too full with its ordinary work to be able to do anything much in the way of alteration of its original structure.

A Departmental Committee is now considering the future policy of the Ordnance Survey, and if this should decide to recommend drastic measures for overtaking the admitted arrears of 25-inch revision, an opportunity will arise for getting rid of the inconveniences and expense of separate series, and recasting the whole 25-inch survey on national lines on a single projection. All the maps of Great Britain, large scale as well as small, can then be projected on one and the same system, with great gain in convenience, in accuracy, and in other directions; especially if all these maps are based upon a grid system.

Before going farther it would be as well perhaps to explain exactly what is meant by a grid system. The existing "25-inch" series, extending only to the limits of a county, or a small group of counties, may be regarded as flat plates stuck on to the surface of a sphere. To project an area so large as Great Britain upon a single plane one must first imagine the surface of the country as depicted upon a gigantic sphere—like a huge tennis ball—1/2500 the size of the Earth. If a portion of this ball is cut out and laid on a flat surface it will bulge up considerably in the middle. In order to make it lie flat the edges must be expanded or the middle must be shrunk, or both processes must be made to take place concurrently. The system of projection does this mathematically. The meridian of 2° W., the centre of the country and of the projection, is shrunk to the extent of about 1 part in 2000, and the edges are expanded by a slightly larger amount. Having thus flattened the area it can be cut up into map sheets of convenient size and provided with a rectangular co-ordinate system which is far more convenient for all ordinary survey purposes than any spherical or curved system. The plotting of any point, or conversely the measurement of the co-ordinates of any point, will then be greatly facilitated if the whole area of the projection is covered by lines parallel respectively to each of the co-ordinate axes and at fixed distances therefrom. These lines will form a system of squares which is known as a grid.

Plotting or measurement of co-ordinates can then be made from the nearest grid line, and errors due to expansion and contraction of paper, or expansion and contraction of the measuring scales, can be virtually eliminated. The grid, if applied to all scales of map, provides also a simple and convenient means of comparison of one scale with another, and is in itself a complete index of map sheets of every scale. It has many other uses and conveniences which I will not attempt to enumerate, beyond saying that for many purposes

it is essential that the grid square should be some multiple of ten units, though immaterial what the actual unit is. This is a very important consideration which at once points towards a metric unit for the grid system. In choosing this unit however there are several other factors to take into account. The most important are, firstly that the grid squares should be of a convenient size, and secondly that an excessive number of figures should not be required for a co-ordinate. The size of the grid square should be such that the squares do not unduly obscure the detail of the map, and yet be capable of sub-division into tenths by eye with an accuracy not greatly exceeding the limit of plotting error. There seems to be general agreement that the best size is about 5 centimetres, or between 1^{1}_{2} inches and 2 inches. A square much larger than this cannot be sub-divided accurately by eye, and if very much larger allows too much scope for paper-expansion errors. A square much smaller than this looks unsightly, and if very much smaller undoubtedly obscures the detail on the map. The actual size of the grid square on any particular map depends of course on the scale of the map as well as on the grid unit; the two things are not independent variables, and the unit for the grid must be decided with reference to the maps with which it is to be used. I think it will be agreed that of the existing range of Ordnance maps, the 1/2500 and the 1-inch are the most important, and as there are some hundreds of 25-inch sheets for every 1-inch sheet, and moreover since the 1/2500 scale is that on which the most precise work is done, I think that for grid purposes it must be regarded as the basic scale; and that it is in relation to the 1/2500 scale that the grid unit must mainly be decided.

The number of figures in the reference depends entirely upon the grid unit. Numerous figures will always be necessary for references in which precision is needed, but for ordinary work it is desirable to have a short reference, or some means of abbreviating the full reference. In the British Empire there is a wide range of units from which to make a choice. We have the mile, the furlong, the rod, pole, or perch, the yard, and the foot, to say nothing of the chain and the link. We can rule out some of these at once however because their decimal multiples and sub-multiples are not named, and it is undesirable to invent new "units" when there are already too many. On these grounds we can at once rule out the mile, the furlong, and the rod, and put an interrogation mark against the yard and the foot. The foot, and still more so the link, are unsuitable as compared with the yard and the larger units because they require two additional figures in a reference already inconveniently long. The chain might be suitable were it not that the chain square on the 1/2500 scale is much too small (one-third inch), and a 10-chain square much too large. It would of course be desirable to select for the grid a unit in which existing surveys are recorded, but unfortunately that condition would virtually limit us to the link and the foot, both of which, for the reasons given above, are unsuitable.

Practically, then, the choice reduces to the metre, or the yard. At first sight it would appear that the yard, which is a native British unit, and an exact number of feet, should have the preference; but when one goes into the matter it seems that the fact that one is 3 feet and the other is 3 feet and a few decimals does not really make much difference.

In the same way, at first sight, it might seem that as the yard is the unit of most military measurements a yard grid should be more suitable for military purposes.

Directly one goes into the pros and cons a little more deeply the evidence in favour of the metre, and against the yard, begins to accumulate. For civil purposes one of the objections to the yard is that its decimal multiples, 100, 1000, and 10,000 yards, are not named, nor I think do these distances carry any definite conception of length to any one except perhaps drapers, cricketers, and sprinters. On the 1-inch and 1/2500 scales the 1000 and 100-yard squares are 10 per cent. smaller than the corresponding metric squares, and as on both these scales the metric square is, if anything, rather too small, the yard square, being still smaller, is 10 per cent. less suitable.

When we pass from these detailed to more general considerations the arguments in favour of the metre become very much stronger. There is, I think, a considerable consensus of opinion that if it were not for the difficulty of change we ought to have followed the example of continental nations and adopted the metre for our unit of length long ago. Numerous attempts have been made in Parliament and elsewhere to introduce metric units into the national life. The scientific world has already succeeded, as have certain large industries such as the electrical and motor tyre industries. Other industries, especially the new aeronautical industry, will almost certainly have to follow their example. The metre, in short, has already obtained a foothold in this country, and all that we need do is to try and make the further voluntary adoption of metric measures as easy as possible.

It is worth noticing in this connection how narrow has been the margin of failure in some of the attempts at compulsory adoption. When further it is remembered that this failure must have been largely due to the fact that the adoption of metric units of length has generally been linked with the much more difficult questions of metric coinage and weights, I think it must be admitted that, on general grounds, the case against the selection of a metric grid unit is not strong. If the adoption of metric units is desirable at all this at least can be said with, I think, some confidence—we must avoid at all costs doing anything now which will make their adoption more difficult. This argument is, I think, decisive against the yard. If the yard is adopted as a grid unit now, and all our 25-inch maps are redrawn on a yard grid, the loss of accuracy and cost of changing to metres will be so great as to make any future change for practical purposes impossible. On the other hand, if it is decided to adopt the metre, the chances of there ever being any pressing necessity to change from metres to yards seem to me very remote.

It is important to remember that the adoption of the metre as the grid unit will not compel any one to carry out surveys in that unit, or to change the existing units of area in current use, or to make any other alteration in present procedure unless anything is to be gained thereby. It is quite likely that there may be a gain in changing to metres if and when a metre grid has been adopted, but the fact that the metre is adopted will make nobody one whit the worse off than he is now.

It remains now to consider whether, if the metre is adopted as the grid unit, it is desirable to adopt the metre also as the unit of height measurement. It

may be said at once that there is no direct connection between metric grids and metric heights. At the same time it cannot be denied that there might be some convenience, such as in calculation of gradients, if the unit of height was the same as that of the grid. For certain purposes—air-navigation is one—it is desirable to contour the map in metres. The international map, already widely used for long-distance navigation, is contoured in metres. Either the airman's altimeter must be graduated in metres, or he must be able to convert an altimeter reading in feet to the corresponding metric figure. It is obviously inconvenient if all aeronautical maps are not contoured in the same units, and if aeronautical maps are contoured in metres there are obvious advantages in having ordinary maps contoured in the same way. There is no immediate necessity to consider a change from feet to metres, unless the Government decides to undertake the contouring of the 6-inch or 25-inch maps, or any parts thereof, at a closer interval than the 100 feet at which the 6-inch is now contoured. If it was decided to contour the 6-inch map at some closer interval, say 10 feet, and at some future date it was desired to change these 10-feet contours to metric contours a decided loss in accuracy would be inevitable. If metric heights are to come at all (it may be mentioned that the recording of heights in metres was recommended by the Metric Committee of the Conjoint Board of Scientific Societies in 1918), then it might be preferable to do the accurate contouring on the large-scale maps in metres, and to retain the foot for the small-scale maps (where the contours are really form lines and are not required to give exact indication of absolute height), at any rate till the metric contouring of the whole country is complete.

Metric contours would require the conversion of the existing level net to metres and the alteration of the heights of bench-marks. It would not however necessarily entail the scrapping of existing levelling staves. Levelling could still be done in the field in feet, and readings converted to metric values.

There is one further point which must be mentioned in this connection. The adoption of a grid system (whatever its unit) makes it particularly desirable that the range of map scales should be one of exact multiples. The 1-inch, $^1/_2$-inch, and $^1/_4$-inch, for example, are exact multiples of one another. By this means indexing is greatly simplified and all sheets of whatever scale can be made exactly the same size with greatly increased convenience in handling and storage. All our present scales are not exact multiples of one another, and the introduction of a grid would make it desirable to consider the alteration of some of the existing "inch" scales into corresponding decimal fractions. For example, if the 1/2500 scale is taken as basic, 1/10,000, or 1/12,500 would be preferable to the "6-inch," and 1/250,000 to the existing "$^1/_4$-inch." Whether it would be desirable to replace the old and familiar 1-inch scale with one on 1/50,000 or 1/62,500 is doubtful, but it is worth remembering that if any change in this direction is desirable, the present happens to be an exceptionally favourable opportunity, unlikely to recur, of making it. We have, as many people know, just commenced re-drawing the 1-inch of England. It has a grid of 5000 *yard* squares, but less than one-quarter of it has been completed. It is not too late to change either the scale or the grid, especially as we are contemplating changes in the method of drawing in order to facilitate keeping the map up to date. We could take advantage of any such change in technique

to effect the change in scale without serious extra cost if such change was thought desirable. The public has not as yet made much use of the yard grid, so that a change of unit here would cause little inconvenience.

I think enough has been said to provide material for discussion. Before inviting others to take up the running it might perhaps be advisable to add one word to make it clear that there is nothing in these proposals which will compel anybody to adopt metric units for current work. The proposals are only concerned with the adoption of metric units for the grid.

The PRESIDENT: We have with us Brigadier MacLeod's predecessors, Brigadier Jack and Brigadier Winterbotham. I ask them to be good enough to comment on what Brigadier MacLeod has said.

Brigadier E. M. JACK: I find myself at some slight disadvantage in not having seen any note of what Brigadier MacLeod was going to say this afternoon. In fact the only note that I have prepared on the subject of Ordnance Survey maps deals with an aspect of the matter which has not been touched on. But I have a short comment to make on the subject of the grid.

On the question of having a single projection and single grid for all Ordnance Survey maps I think there can be no two opinions. In fact the very suggestion that there is a possibility that we may have all our maps on one projection seems almost too good to be true.

Brigadier MacLeod has told us that the introduction of the metric grid does not imply any change of units. That of course is perfectly true. At the same time I think one cannot get away from the fact that it will introduce a new unit and, to some extent I think, a mix-up of units. The national units to which we are accustomed in visualizing distances are miles and yards; the metric grid will be of course in metres.

It has been said that the grid is independent of scale, that it is merely a convenient means of identifying position and calculating distances. I agree that that is so to a large extent; but the fact remains that a system of squares on a map provides a most convenient means of measuring and estimating distances. It is actually a scale printed on the map, and it is available no matter how small a portion of the map is exposed. To that extent therefore the fact that the grid squares are not in national units will be a disadvantage and an inconvenience. In spite of that however I agree that the reasons advanced by the Director-General for introducing the metric grid are very cogent. It will certainly be of the greatest value to those who have to use the grid for computations, and they are surely the people who matter most. I therefore should not personally be opposed to its introduction. There will undoubtedly be much criticism and probably fairly voluble protests on the part of the public, but as the Director-General will have to bear the brunt of these we may perhaps view the matter with equanimity.

On the subject of heights and the possible introduction of the metre for heights and contours, it seems to me that the use of the metre does not matter very much in the case of small-scale maps, but for the larger scales there is some advantage in the smaller unit, the foot, for contours.

On the subject of scale I really have nothing to say except that I do not envy the task of the Director-General who proposes changing the 1-inch to 1/62,500. Brigadier MacLeod did mention the possibility of overhauling the

½-inch. If it is found possible to do that I should welcome it very much indeed. I have always thought the ½-inch was not up to the high standard that we have for the 1-inch and ¼-inch.

Brigadier H. S. L. WINTERBOTHAM: I should like to echo the words with which the President opened the meeting. The country is troubled about its maps to-day, not because of the design of those maps but because they have got out of date. Post-war economies have let us down. The changes in the country have been rapid. Yet it remains a fact that in wealth of scale and in accuracy of presentation there is no country of the contemporary world which can hold a candle to England, and that is not of course a mere expression of individual opinion. Without question what the man in the street wants now is revised plans and revised maps, and the sooner he gets them the better. That is what he is out for. He is not looking for revolution; he is looking for the maps which will represent the country as it now is.

I had hoped that we should talk this afternoon a little more generally about the various publications of the Ordnance Survey, and that we should have thought particularly of scope and purpose. It seems to me that this question of metres *versus* yards is a mere, shall I say, trifle; but the time is going on and it is obviously this trifle that we have to think about. Therefore I should like to answer one or two points.

The question of the precision of definition that you can get out of a large unit or a small, in any Survey measurement simply does not arise. Supposing for example you had your grid in miles on some maps and in inches on others, the same accuracy can be got in either case. It is a mere question of the position of the decimal point.

Let us consider what was done in the way of the yard grid in France. We fought the war, you know, upon one of the most muddled British systems of reference that could well have been devised and ultimately it defined positions in yards. We fought the whole war on yards, and in the last few months or so we decided to become metric, in such a hurry that the first sheet of the new metric grid was almost ready when the Armistice came. For practical purposes then the yard obtained the whole time.

After the war came the question of what unit the map training of the soldier should be based on, and whether he should be trained to think metrically or not. As we know, he does not think metrically in gun sights or gauges or speedometers: he functions, being a representative cross-section of the nation itself, exactly in those units in which he has been educated in the primary school. However it was decided to have the metre grid for military purposes, and later—it was about 1927—Brigadier Jack at the Ordnance Survey and I took up this question together from the point of view of eliminating unnecessary duplication of editions and of having a national map which would be so national as to satisfy the soldier. We came to an amicable arrangement. The grid was put in yards. Neither of us thought the adopted solution ideal, but we pooled our interests. We exchanged letters between the War Office and the Ministry of Agriculture and Fisheries to seal our agreement, and the yard grid came into being. That yard grid has now covered not only all existing sheets of the new Fifth Edition, but also a great deal more than half of the new ¼-inch of Great Britain; that yard grid is upon

the 10-mile map and also upon the 3-inch of London, so that, you see, the whole of London, gridded in yards, is now available at 3 inches to the mile, at 1 inch to the mile, at $^1/_2$ inch to the mile, at $^1/_4$ inch to the mile, and at 10 miles to the inch. So that it behoves us to think about this matter.

We are told it is not too late to do another quiet change now. Well I think it very questionable.

We are told that the introduction of the metre has only been refused by narrow margins in each of the many cases in which it has been suggested. But in any case the metre was refused and the yard remains the unit of the man in the street. If we are to be put on a metric grid and if it is to measure anything, is the position not something like this? The Ministry of Transport at the taxpayers' expense makes a large factory for the building of motor cars many of which are to be sold, in competition with private interests, to the public. The designer of the 1936 Model installs on the dashboard a speedometer in metres and a petrol gauge in litres. The attitude of the British public to such a motor would be: you may either change it or keep it.

Now let us look at the question of heights. At a great deal of expense the Ordnance Survey surveyed certain contours throughout Great Britain. The policy in 1850 to 1870 was changing so rapidly that the vertical interval does not remain the same in every part of the country; there is a good deal of variation between county and county; but at any rate the bulk of those contours were spirit-levelled throughout Great Britain at certain altitudes in feet above the Liverpool datum. Those contours are not capable of being put into the metric system unless vertical intervals include decimals of a metre. It would therefore be necessary either to survey them again or to acknowledge the loss of accuracy due to interpolation. But if it is a case of pleasing the aeronaut, the latter is not thinking of decimals of anything and he is not using any scale for flying save perhaps the $^1/_4$-inch or 10-mile. To put a simple metric layer system on either of those scales is a matter of a few hours. To change the system of contouring on the large scales which govern industrial development is of course a very different matter.

But we are told that there is some trouble inherent in the fact that there are no names for multiples or sub-multiples of our national units. Such names have been freely suggested in the past. For example we have had suggestions for a kilo-yard. I am not very fond of these doubtful Greek words, but still it is easy enough to add a new conception to existing familiar units.

Lastly comes what seems to me to be rather a powerful point. If the country decides on a metric system—and why not? the metric system has a great deal to say for itself—it is the people who must do it. It is not for the Ordnance Survey to act as dictator. And if we do go metric, then no doubt some of our scales will change, but to suggest a change in the 1-inch or 6-inch now implies such a change in office and survey equipment and such a drop in the value of the records of a hundred years that the Post Office might well break down under the flood of protest which would come.

Colonel P. K. BOULNOIS: Unlike the last two speakers I did have the advantage of glancing through Brigadier MacLeod's paper before I came here, but as it was only during the 'bus journey from the War Office here I am afraid that I have had no time to prepare any very considered comments.

I must confine myself entirely to the one problem of the grid and a very difficult problem I think it is. It keeps on cropping up, this yard *versus* metre question, and one might refer to it as a hardy annual or perhaps biennial. To get a perfect unit for a grid is in my opinion almost an insoluble problem: as insoluble as that other problem of how to design an aeronautical map, which as you know consists of trying to show the detail which can be seen on a 6-inch map on one of a scale of about one-sixteenth of an inch to the mile, and it cannot be done. I rather feel that it is the same to try and find a grid unit which will be convenient on all scales of maps.

The question of Army training has arisen, and you have already heard it referred to, so I won't say much more about it. The Army is being trained and has got to be trained to use any unit of measure, and I do not think that from an Army point of view it matters very much what unit is used for the grid on English maps. A young gunner recently said to me: "Here am I using a map on a scale of 1 inch to 1 mile, measuring heights in feet, with my ranges all measured in yards, yet its grid is in metres and the guns are dragged by horses measured in hands." That I think sums up the Army attitude. They have to be prepared to use any grid no matter whether the unit be yards, metres, feet, versts, or Abyssinian toises. For them it is just a question of using whatever happens to be on the map of the country concerned. On the whole, from the Army point of view, we should prefer the metre grid perhaps, because that unit is the continental one, and as far as one can tell, any "League of Nations" war is more likely to be on the continent than elsewhere. So I think from that point of view the metre comes first, and we should be glad in the Army to see Ordnance Survey maps gridded in metres as giving better training.

As to the Royal Air Force, you have already heard that they like their heights in metres. They are coming to that undoubtedly, and the Geographical Section who have to produce maps for the Air Force as well as for the Army are going for metres as the height unit for R.A.F. maps. Grids on the other hand leave them cold, and at the moment the Royal Air Force are saying to me "please leave off all grids on our maps; we much prefer the graticule." The graticule, as I feel sure is well known, is the system of parallels and meridians by which reference to position can be given. It is used by sailors and has world-wide application. That is all I have to say about grid units from an Army and Air Force point of view.

From the point of view of a civilian user of Ordnance Survey maps and as a taxpayer I am, I must own, a little shaken at the thought of seeing a metre grid on our national maps. There may be great advantages scientifically in metres, but it would mean having kilometre squares on the face of all small-scale maps, and that I think would be disliked by most users. One of the things one uses the grid on a small-scale map for is, as Brigadier Jack has pointed out, as a convenient measure of distance. Surely when one is using a 1-inch-to-1-mile map the greatest convenience ensues when the grid lines are 1 mile or multiples of 1 mile apart. The same applies to the $\frac{1}{4}$-inch-to-1-mile map. Kilometres would be no convenience, and the same applies to yards. I do not know whether any of you have used the Ordnance Survey 10-miles-to-1-inch map, which Brigadier Winterbotham published when he was Director-

General, for motoring. On that map you have grid lines which are 50,000 yards apart. To work out rapidly in one's head the distance apart of two places in miles when the grid is in yards is more than a difficulty: it is a nuisance.

And that brings me to the question I should like to put, and that is "Why has the mile been hitherto so completely kept out of the discussion as being a possible unit for the Ordnance Survey grid?" As far as I can see the only argument against the mile is that there are no names for its decimal divisions and subdivisions. But actually the mile seems to me much the best unit from that very important point of view—the suitability of the size of the grid square. On the 1-inch scale the mile grid would obviously be 1 inch, a very much better size than either 1000 metres or 1000 yards, both of which make squares which are too small. On the $\frac{1}{4}$-inch-to-1-mile map the grid square would be of $2\frac{1}{2}$ inches side for the 10-mile square, and this is pretty well the ideal size for any grid square. On the 1/25,000 War Office map the grid would approximate again to this ideal size, though of 1-mile side instead of 10 miles. Finally, on the 1/2500 Ordnance Survey plan one would get this ideal size of $2\frac{1}{2}$ inches for the grid square, though here one would have to come to the decimal part of the mile, one-tenth, as the unit and as the grid square. It is here that one comes up against the difficulty, if it be one, that there is no name for the tenth part of a mile, but even so I have yet to be convinced that the English mile is not really the best answer to the problem of what is the best unit for the grid for Ordnance Survey maps. On all the scales except perhaps the 6-inch you would get a better size of grid square than you will with either the metre or the yard as your unit. In fact to sum up my views, may I make a little misquotation "What's in a name? The decimals of a mile by any name would sound quite sweet," for it is in that feeling that the decimalization of the mile is impossible that it seems the metric system has been turned to as the only sound solution of the grid unit problem. Would not the mile be a better unit?

Captain CRONE: I have very little experience of working on maps in England, probably far less than any one else in the audience. I should like to refer however to the point as to uniform projection. Brigadier MacLeod gave us a very good analogy and showed how it is impossible to get a portion of an egg-shell to fit on a flat surface. He said you peel off the egg-shell, put it on the table and it bulges. The normal way in which the ordinary person would put that egg-shell flat on to the table would be to take something flat, put it on the egg-shell and press it down. You would then have a large number of small pieces of egg-shell lying on the table, and all sensibly flat on the table. If the original piece of egg-shell were the size of the country, each of those little bits will be similar to the size of the map sheet. If you apply that analogy to the mapping of an area such as the British Isles you must get down to bounding your sheet by the graticule line. Colonel Boulnois has referred to the value of the graticule and these little bits of egg-shell, if all are similar, will be bounded by lines of latitude and longitude, and each map sheet will be on its own projection; that is to say, you must have a polyconic projection. By this method you have none of the troubles inherent in a grid, such as the grid no longer lying north and south as you get away from your origin and the squares of the grid not being the correct size as you get up to the edges of the projection.

You have a uniform unit though it varies in size from place to place on the earth's surface. It is a minute of latitude, that is, nearly a nautical mile north and south, and a minute of longitude which is considerably less, about three-quarters of a mile in these latitudes. You have in fact a unit very similar to the mile unit which Colonel Boulnois has suggested. But your projection need not stop at the British Isles. You could cross to the Continent and use your same latitude and longitude and your "grid" reference, and in fact it is world-wide. Every map that is published on normal scales has latitude and longitude marked on it, so that it has an inherent grid on it, whether the map is ruled up or not. I think while we are considering this question of grids and units for grids we ought to consider the obvious logical "grid," that is the graticule, which is universal.

Sir GERALD LENOX-CONYNGHAM: I had the advantage of being allowed by Brigadier MacLeod to read his notes on the Memorandum a day or two ago. I have been thinking a good deal on the question and finding it a difficult one to decide upon. One important consideration is, what will the public stand? I feel that there would be strong objection on the part of the public to depart from the inch-to-the-mile scales. I fear that would lead to much opposition. Against that it may be said that the public have accepted the scale of 1/2500, which is commonly spoken of as the 25-inch to the mile, which it is not. Perhaps the public would accept the logical procedure of starting with the scale of 1/2500 as the fundamental map and reducing by successive factors to 1/25,000, and so on, and would give up the inch-to-the-mile scales; but I think it is doubtful.

As to the grid; if on all our maps grids were printed which were a certain number of metres square and if positions were defined by co-ordinates expressed in metres, I do think the public would probably take no notice of it. I happened this morning to have occasion to look up the name of a small village in the quarter-inch Atlas. I looked in the index and found it was in square A6, and I have just been trying to think what was the size of that square. At the time I paid no attention to its size and did not know that it was a 2-inch grid. I believe that the public would just regard the grid squares on the map as a convenient form of index to help them to find places that they wanted and would not consider whether they were in metres, yards, or feet. I believe it would be safe, if the arguments in favour of the metre are sufficiently strong—and about this I have great difficulty in making up my mind—for the Ordnance Survey to print metre grids on the maps and to express the co-ordinates of points in metres, but I think it would not be safe to alter the 6-inch or the 1-inch scales.

Mr. A. R. HINKS: Captain Crone has spoken about the mesh, which I believe is the correct name, though he called it a grid. It seems to me difficult to maintain that the division of the minute of latitude and longitude into decimals, tenths, or hundredths, is convenient; but even if it is the most convenient system in the world I think that for clearness of definition and avoidance of confusion we ought to distinguish between the mesh and the grid. I believe the War Office feel that that system which is used in India, no doubt with admirable effect, is not a grid at all and should not be called that—it is a mesh.

Mr. M. PORTAL HYATT: Speaking as a Fellow of the Society and as a practical surveyor, I think the grid idea is excellent, but it is one that will be of interest only to practical surveyors. The average man in the street will be absolutely indifferent to it and, what is more, as a practical surveyor if I had to work to it I should always have to be converting the co-ordinates and all dimensions on the metric system to feet, and you can realize what the error might be. If in my business a man came to me and wanted to buy some land and I said it was so many kilometres in length he would ask me what I was talking about. In business it is necessary to be able to put the things in an understandable way. Although in theory the idea is a good one, it would be much better, from the wider point of view, to have the grid in miles or feet. On the 1-inch map you divide up in miles and then co-ordinate those grid lines on the 25-inch in feet. They are all on the same basis and you would not be putting to the public something which they do not understand and which they are determined not to understand. For that reason I think the metre system on the grid would be a disadvantage.

The Ordnance Survey does a lot of valuable and very necessary work, but it needs to be relieved of a certain amount of detail work which should fall on others. The Chartered Surveyors' Institution have formed a special Committee, of which I am a member, and I intend to propose that legislation be instituted whereby it will be compulsory for plans to be prepared and deposited by licensed surveyors. That should relieve the Ordnance Survey of a great amount of detail work which that department now has to do.

Professor C. B. FAWCETT: This matter has been discussed so far almost wholly by the surveyors who have to produce the maps. It seems to me that it may be worth while to know the views of persons primarily concerned with using, and teaching students to use, maps.

We have at the two ends of the Ordnance Survey series on decimal scales, the 1/2500, nominally 25 inches to the mile, and the 1/1M. It seems to me we should derive enormous advantage if the intervening maps were on scales easily comparable with those. That is a point which I think should carry weight. In spite of the fact that there is a considerable amount of inertia in public opinion, which has been stressed, the public would certainly support strongly the suggestion that the scales of the intervening Ordnance maps might, with considerable advantage, be in the decimal series.

One point which has not been noted by any previous speaker is that for the past generation in the great majority of schools in this country, in all secondary schools, and now in most elementary schools also, the metric system has been a subject which has been definitely in the time-table, a subject in which most pupils have been instructed. Every boy or girl who has studied the elements of science in the secondary schools has had some exercise in the use of measurements on the metric system both for length and for weight. Therefore it seems fair to assume that the majority of the public in this country understand, although they may not be familiar with, the metric units and the decimal system. So the difficulty of transition to a decimal system would not be so great as those of us who have forgotten our familiarity with that system tend to think. I think the difficulties are much less than many have suggested.

Further, if it were possible to put into operation the simple proposal which

Brigadier MacLeod made, namely, to insert a grid in metric units on to the Ordnance Survey map, then that grid would of itself serve as another scale on the map. In fact I find that I and many other people who use a map do use the squares on the map as a convenient scale which is visible however the map is opened. There is a scale in inches and miles on the edge of the map. If there were also a scale of metres on the face of the map itself it could cause no inconvenience to those who do not want to use it; but it would be a practical convenience to those who do think in metres, and some in this country do, and it would add considerably to the value of the map.

It is perhaps worth while where possible to give a lead to the public. The suggestion that any advance in any branch of science should wait until the man in the street understands it is a suggestion that would put a stopper on every advance that could be thought of. If it is not for those who are leaders in the art and science of map-making, and the British Ordnance Survey is that, if it is not for such men to give a lead, then to whom shall we look?

Brigadier M. N. MACLEOD: I will try to reply to the comments we have heard, but first let me make the point that any change which is made now—the adoption of the metre or adoption of the yard, whichever it is to be—has got to last for a very long time indeed: perhaps fifty or one hundred years.

Though I agree with every speaker who has commented on the indifference or the reluctance of the British public to change, I do not think that necessarily means that the British public is always right. If we consider, as perhaps Brigadier Winterbotham considers, that our existing units are the best possible, then let us do everything that we can to make the change impossible. If, on the other hand, there is anything intrinsically good in the metric system (and there are many who think so—I think some people who oppose it may not have studied its merits very carefully) and any advantage in coming into line with foreign countries, let us do nothing to make that more difficult. These are some of the reasons why I think it would be preferable to adopt the metre for our grid system rather than the yard. I agree that the public might object to a change to metres, and also that the change is difficult. But at the same time, as one of the speakers has said, for many of the purposes for which this grid is used the public will not care two pins whether it is the yard or the metre, if indeed they make use of the grid at all.

I have not time, and also it would be rather technical, to plunge into a discussion of the merits of a grid system as compared with the mesh system to which Captain Crone has referred, but I am quite certain that the mesh system would not be practical for this particular purpose.

Some of the other criticisms which have been levelled at the use of the metre grid system—in fact practically all of the criticisms—have been based on the use of that system for our 1-inch, $\frac{1}{2}$-inch, $\frac{1}{4}$-inch or 10-mile maps. I prefaced my remarks, you will remember, by saying one must select one scale out of the range and adopt the unit to suit that scale. I suggested that in the case of the Ordnance Survey the basic scale was the 1/2500, and that it was with reference to that scale that the grid unit should be selected. Consequently, though I admit the metric grid may not be suitable for some of our small-scale maps, the 1/2500 map is the one we have to consider. I do not of course suggest that we should necessarily change from our existing inches-

to-the-mile to decimal units all round; indeed, I think that the 1-inch is so well established that it might be unwise to envisage a change there at present. At the same time I feel quite confident that the public would not notice a change of the $\frac{1}{4}$-inch to 1/250,000.

I would like to make it clear that there is nothing in these proposals which makes anybody who now surveys in feet, survey in metres, or any other unit; and as for the difficulty of changing co-ordinates given in metres to co-ordinates in feet for survey purposes, the possibility of error in that change is hardly any more if the metre rather than the yard is adopted.

Lastly, there is no suggestion in anything I have said of the Ordnance Survey forcing this "change" upon the public. The Memorandum, to which Sir Gerald Lenox-Conyngham referred, which was the basis of my discourse to-day, is one that I have prepared for the Departmental Committee, and in it I have put the pros and cons of the two units before them as far as I am able. I have asked the Committee to invite comment on this particular point from all those who are giving evidence. I think that a question of this sort—the adoption of the metre or the yard—is so fundamental that it might even be desirable to take the matter before Parliament. At any rate I want to make it clear that I do not propose to decide it myself!

The PRESIDENT: Before we close the proceedings there are one or two Fellows who have mentioned other points which would, it seems to me, be of interest if touched upon. One is the question of the treatment of canals in the Ordnance Survey maps.

Mr. ARCHIBALD BLACK: I think it safe to say that on any Ordnance Survey map which marks waterways I could guarantee to find a mistake: and I certainly would not guarantee to find a mistake in any other feature which they mark. I think this question of waterways is worthy of attention, and I am going to take one particular sheet of the 1-inch map as an example, a fairly typical example, No. 113, the Reading–Newbury sheet. There are ten locks marked on the Thames on that sheet. Of those, three are not marked on the map with their proper symbol. They have the word "lock" against the place where the lock is, but no symbol is shown. There is a symbol in the characteristic sheet; and this appears for the remaining seven locks. This is inconsistent. Of thirty locks on the Kennet and Avon canal which should appear on that sheet two are not marked at all, two again have the word "lock" but no symbol; in three the symbol is not the same as that on the characteristic sheet; and eleven are marked with the lock falling the wrong way—the symbol is turned round. So out of thirty locks on that canal eighteen are in some way not adequately represented. That is on the Fourth Edition. The Fifth Edition is very much better; but on the Thames they have now got three locks falling the wrong way, including one correctly marked on the Fourth Edition; and one which has no symbol.

There are some sheets—Luton is a good example—of the Fifth Edition which are very nearly clean: one is surprised to find a very few mistakes. But to take another example: there are six locks at Woodham on the Basingstoke Canal. I do not own the ordinary Fourth Edition sheet covering this, but I do own the Middle Thames district map, which is similar if not identical. Of those six, the bottom lock is marked falling the wrong way, the symbol

being turned round; the second is marked with the word "lock" but has no symbol. Three and four fall the wrong way; the fifth has a symbol, but faulty, and the sixth lock is not marked at all. By way of cleaning that up in the Fifth Edition they have not marked the bottom lock and have turned the others round so that they all fall the wrong way. So much for destructive criticism.

In constructive criticism I think it is unnecessary to write the word "lock" at all. It is quite unnecessary to fill up the map with the letters, which are so much more detail and so much more expense. But if this is to be so it is important that the symbols for locks should be drawn correctly; and that where the river divides into several branches on one of which there is a lock, on the others weirs or mills, they should be clearly marked so that it is possible for a person going up the river in a boat to navigate satisfactorily using the 1-inch map. It is quite easy to mark everything that is wanted. Considerable attempts have been made in a half-hearted manner to get it done in the past.

The PRESIDENT: I am sure the Director-General will remember that attack on the locks and take any action that is possible in regard to them. Then Mr. David Hinks would like to make some observations regarding the treatment of the drainage in the Fen district.

Mr. DAVID HINKS: I must ask you to forgive me for continuing on more or less the same subject. In the fens of the Bedford Level the rivers are embanked, and serve both for drainage and for navigation, and the faults which are to be found in representation of them are sometimes very grave.

The most important features of the country are the pumping engines on the land below the sea, the embanked rivers, and the sluices through which the water flows out from the embanked rivers at low tide and which prevent the tide's overflowing the land when it rises. No pumping engine is marked characteristically on the 1-inch sheet, unless it happens to be a derelict windmill. All the active engines, and also all the old steam-engines, which are perfectly characteristic as landmarks, just as characteristic as windmills, are simply marked as buildings; they might be anything. Also, what is perhaps more important, a number of the sluices are not marked at all, so that it is impossible from the 1-inch map to understand the drainage. It is also impossible to see where you can navigate.

I cannot show examples without a map, but I can mention one important case. The River Ouse flows 21 miles from Earith to Denver in an artificial cut called the New Bedford River, parallel to the Old Bedford River which drains the land immediately to the north. There is a sluice at the lower end of the Old Bedford River which lets the water run out at low tide. That is not marked. The space between the two rivers, which is called "the washes," is used for flood water to bed in, to relieve the strain on the New Bedford River. When the river is in flood from the land-water coming down, these washes are flooded. They form a kind of safety valve. The water is run in by a sluice at the top end which is not marked, and runs out into the New Bedford River at the bottom end through floodgates, which also are not marked. Both these stand in cuts perfectly plainly marked on the map. So there again the purpose of the cuts is obscure to any one who looks at the map.

There are also some locks misrepresented or omitted which are essential for navigation, but I cannot enlarge upon those now.

The PRESIDENT: I certainly feel, and I am sure the Council of the Society also, very grateful to the distinguished surveyors, the two ex-Directors-General of the Ordnance Survey, and Sir Gerald Lenox-Conyngham for having taken the trouble to come here and give us the benefit of their views. It is not for me, even if I had the qualifications, which I have not, to make any pontifical pronouncement on the merits of the grid question, but what has been said will be of great value to the Society, who have been invited to express their views on any point which concerns them particularly to the Departmental Committee. I thank you, gentlemen, very much for giving us this informing afternoon. The discussion will enable us to submit to the authorities concerned a very much more weighty expression of opinion.

As indicating the different points of view from which the matter may be examined it may be useful to annex the following notes on Scales, Grids, and Contours extracted from a Memorandum prepared during consideration of the subject since the above Discussion took place:

Scales.—The British units of measure, not being decimal, do not lend themselves quite readily to the choice of scales on what is called the natural system, that is to say, with representative fractions good round numbers, as 1/250,000, 1/125,000, etc. But since by good fortune a mile contains 126,720 half inches and 253,440 quarter inches the representative fractions of the half-inch and the quarter-inch maps are very close to these natural scales, differing from them by only one part in 73, or 1·36 per cent., which is scarcely if at all greater than the uncertainty of scale of a printed map due to changes of moisture content.

Thus, if the quarter-inch map at its next revision were drawn on the scale 1/250,000 instead of 1/253,440 the difference in ordinary use would be inappreciable, though it would look more important if the map were described as 3·94 miles to the inch instead of 4 miles, simply because the number used begins with 3 instead of 4. But if one wrote

Scale 1/250,000 or closely 1/4 inch to the mile

in place of

Scale 1/4 inch to the mile or 1/253,440

there is no reason why the map should not be known still as the familiar Quarter-inch, just as the 25·344 inches to the mile, the 1/2500, is usually called the 25-inch, even by surveyors who are constantly making measures upon it and know that it is not.

If necessary the same argument might be used for turning the one-inch map from 1/63,360 into 1/62,500; but not for turning the six-inch map from 1/10,560 to 1/10,000.

The six-inch map suffers from the disadvantage that it is neither a fully coloured topographical map nor a cadastral map, since roads and their boundaries are not shown truly, but widened conventionally, especially in towns. Hence accurate measures of areas and dimensions of properties

cannot be made on this map, even to the degree of accuracy that one might otherwise expect as proper to the scale.

On the other hand, the map is on a scale unnecessarily large for much of the open country, and with fine drawing the detail could be shown on half the scale, except in built-up areas. It is understood that there is a demand from the Army for a map on the scale of 1/25,000. If there were no objection to this map being sold to the public, it might probably take the place of the six-inch, except in towns, and they might be better served by maps on the scales of 1/10,000 or 1/12,500, which would have the advantage of being accurately one-fourth and one-fifth respectively of the scale of the basal 1/2500, inaccurately called the 25-inch.

This question of natural scales, in round numbers, has nothing to do with the question whether the unit of length shall be the yard or the metre. By a happy chance the base map of the British surveys is on a natural scale, 1/2500, and there seems to be no intention whatever of changing that. That being so, there are evident advantages in having the smaller-scale maps simple submultiples of it.

If then, starting from the 1/2500, we were to lay out a new scheme for the maps of Great Britain we might very properly arrive at the following:

1/2500 the existing cadastral map.
1/10,000 or 1/12,500 to replace the six-inch map in built-up areas.
1/25,000 for military use and to replace the six-inch map in the country generally.
1/62,500 to replace the one-inch map.
1/125,000 to replace the half-inch map.
1/250,000 to replace the quarter-inch map.

To propose such a completely new scheme is perhaps not necessary. There is urgent demand for a rapid revision of some of the sheets of the six-inch map in rapidly developing areas, and this must presumably be done on the old scale. There is an admirable new one-inch map in course of publication, presumably too far advanced to be abandoned or much altered.

But the half-inch and the quarter-inch must in the near future be redrawn in the style of the one-inch, and there seems to be no difficulty in making them into 1/125,000 and 1/250,000. If to these is to be added a new 1/25,000 we shall have gone a long way on the road desired by many without making any changes that could be seriously resented by the most conservative map-users.

The Grid.—When some five or six years ago it was resolved to adopt the Transverse Mercator of Gauss Conformal projection for all maps of the Ordnance Survey as they were redrawn, it was natural to seize the opportunity of adding a grid to the maps, which they had never had before in any proper sense. The choice of a unit of length necessarily presents great difficulty, for the grid, to be convenient, must be strictly decimal; that is to say, if on a given scale a grid-square of say a thousand units is inconveniently small, it is proper to use a square ten times as big, but not five times. If then the scales in use are to one another in binary progression, the inch, the half-inch, the quarter-inch, it is impossible to choose grid squares in decimal

progression which shall be convenient on all the scales, especially since maps are normally folded into small sections for use in the field, and it is essential for military use to have at least one grid line for each co-ordinate on each section.

For the unit of length it was possible to choose the mile, the yard, the foot, or the metre.

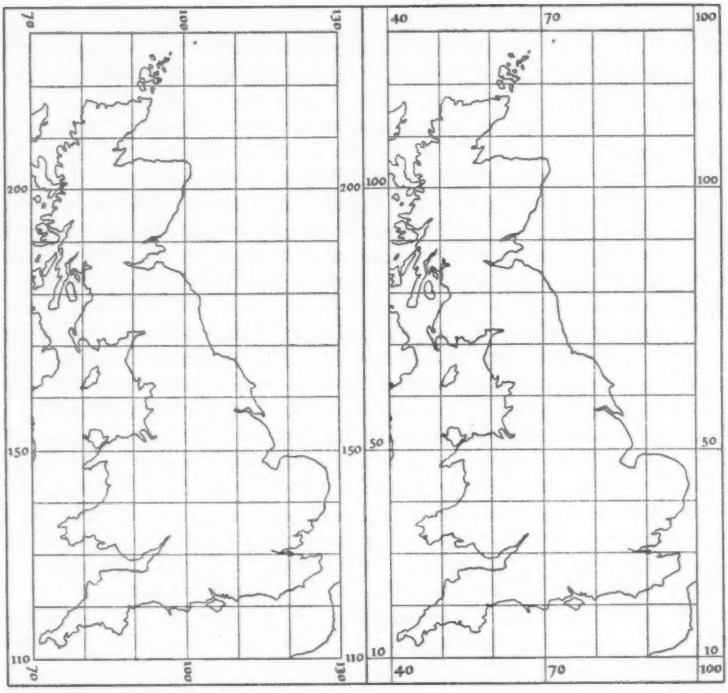
The mile had the disadvantage that no Briton thinks in decimals of a mile; the yard had the disadvantage that no one except an artilleryman thinks in thousands of yards; the foot had no advantages at all, except that it would have made a grid square of a size convenient for the one-inch map; and the metre did not seem at the time the choice was made to have any particular convenience for British use.

After discussion between the principal people concerned in the matter in 1927 the unit adopted for the National Grid was 1000 yards, which may be called conveniently the kilo-yard; but this almost required that the grid square on the one-inch map should be 5000 yards, contrary to the first principles of a grid. It was unfortunate that the first British map to bear the new grid should have been so badly served by it, for the 10,000-yard square is of convenient size on the half- and quarter-inch maps, and the 1000-yard square on the six-inch. And one may be allowed to say, with all respect, that the 5000-yard grid might have been used on the one-inch map to better effect. Thus the central meridian was chosen two degrees west of Greenwich, and if the meridian had to be an exact number of degrees from Greenwich, that choice was imposed by the shape of Great Britain. The origin for the computation of the vertical co-ordinates was taken as the intersection of the 49th parallel with that meridian, and that choice was arbitrary. Then, in order that all the east and west co-ordinates should be positive, the number 1 million was added to them, a number unnecessarily large, as will appear immediately; and the same number was added to the vertical co-ordinates, quite unnecessarily, since the most southerly point of England was already more than 100,000 yards north of the origin.

If 400,000 instead of 1,000,000 had been added to the horizontal co-ordinates and no addition made to the vertical, the whole of Great Britain up to north of Inverness would have had co-ordinates to the nearest 100 yards expressed by four digits whereas in the system adopted all the vertical to this order of accuracy are five digit numbers, while the horizontal west of the central meridian have only four, unless for symmetry a zero is affixed.

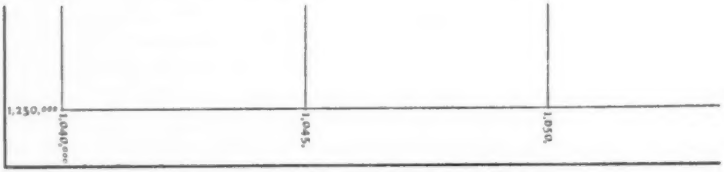
Further, although the square of the grid is five kiloyards, the grid lines are numbered in kiloyards, so that if for example a point is measured on the map as 3800 yards east of a grid line figured 1·170 the grid reference is $1{\cdot}170 + 0{\cdot}0038 = 1{\cdot}1738$, and if the grid line is figured 1·175 it is $1{\cdot}175 + 0{\cdot}0038 = 1{\cdot}1788$. In this arrangement there is plenty of room for blunders. The grid lines should be numbered so that the figures measured are annexed to the figures of the grid, not added to them.

If it were not considered too late to make a change, while retaining the 10-kiloyard grid, it might be renumbered with some considerable advantage, as in the pattern annexed to this memorandum. If, as has been suggested, a metric grid is adopted, the same principles of numbering are applicable.

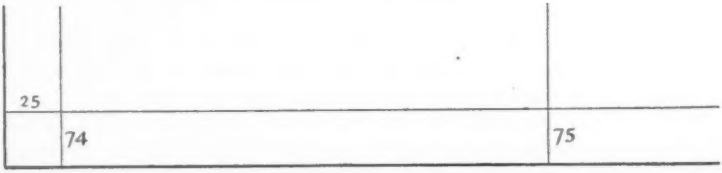


National Grid 1927

Suggested re-numbering
Unit 10 kiloyards



Grid numbering on O.S. 1 inch Fifth Edition



Suggested re-numbering

And if it is desired in either case to print at the corners the full numbering in yards or in metres, the above implies that instead of writing 1,090,000 one should write 1,090,000, and if the intermediate 5 is written it would be better as a small single 5, leaving the fuller numbers for the 10-kiloyard lines only.

It has been assumed in discussion elsewhere that the 10-ky. grid, though placed upon the maps, has not yet come into use, and may be replaced without difficulty. Whether this is so or not would seem to demand inquiry. This grid is found not only on the new one-inch map but on the fourth edition of the quarter-inch, the provisional three-inch of London, the new half-inch of Greater London, and various indexes to accompany the maps. It was announced and described as the National Grid, and its advantages stressed. But it is perhaps not too late to alter it.

If it would be well in any case to replace it by a metric grid seems to depend first upon whether this grid is required for military use, and secondly upon whether the same map can be used for civil and military purposes. It is understood that maps required for military training are often over-printed with a kilometre grid in purple, and that the lines of this grid are heavily figured at short intervals across the face of the map, so that a grid reference may be taken from any small section of the map. There seems to be no way of providing for this without gravely disfiguring the map. And that suggests that there must always be a special edition for military use. If that is so, the advantage of putting the metric grid on the ordinary map is less obvious. But the civilian map should have a grid of some kind; and the balance of convenience seems to lie in the metric grid, with the grid unit one kilometre.

Contours and Bench Marks.—If the suggested new map on 1/20,000 or 1/25,000 is to have heights in metres, the contours for this map must be surveyed in metres, probably at 5-metre intervals. But this does not require that henceforth all contours on British maps should be in metres. By good fortune 15 metres equals 49·2 feet, so that there is a fairly close correspondence between contours at intervals of 15 metres and contours at intervals of 50 feet, and in the first few hundred feet, at any rate, it would seem to be a good deal easier to interpolate for them from new 5-metre contours than from the existing 100 foot.

This would not indeed provide for convenient contours at say 10-foot intervals on the 6-inch sheets. But it may very well be argued that what is wanted on 6-inch sheets is not so much contours, which cannot be marked on the ground, as a large number of bench marks, which might very easily be figured on the 6-inch and 25-inch maps both in feet and in metres.

On the small-scale maps, half-inch or 1/125,000 and upwards, the contours must in any case be generalized, and on the maps take on more of the character of form lines than of accurate contours. It might very well be an acceptable compromise if the contours were drawn and figured in metres and the spot heights given in feet, at any rate during a transitional period. And on the smaller scales which are used for flying, and for the compilation of atlases on such scales as 1/1,000,000, metric contours are essential.

The problem seems to be therefore essentially one for a compromise, and the lines suggested above may be one solution.

THE GEOMORPHOLOGY OF STEWART ISLAND, NEW ZEALAND

GORDON WILLIAMS, PH.D.

STEWART ISLAND is a rugged bush-clad island 45 miles long and 25 miles broad lying off the south coast of New Zealand on latitude 47° S. It is separated from the South Island of New Zealand by 20 miles of water forming Foveaux Strait. The nearest point on the mainland is Bluff, the port of Invercargill and of the prosperous plains of Southland. Oban is the only permanent settlement on the island and lies at the head of Half Moon Bay, a small anchorage on the north-east coast. A high forest growth, consisting mainly of rimu, rata, and yellow pine, and suitable for milling, exists in sheltered hollows at low altitudes, but on the windward sides of the valleys and at altitudes of over 200 feet, it gives way to a dwarfed bush, which still higher, on the windswept slopes, becomes a twisted interlocking and impenetrable scrub clinging closely to the hillsides. The tops of the main ridges are swept continuously by the "prevailing westerlies" and only tussock and moss can survive, and in places extensive areas of bare rock appear.[1]

Stewart Island is a sanctuary for native birds, and as stoats and weasels, which have so effectively reduced the indigenous bird life of the mainland, have not been introduced, native birds, including kiwis, kakas, and wekas, are plentiful. The climate of Stewart Island is disagreeable: the prevailing winds sweep across the highlands driving with them banks of cloud and showers of rain, but snow seldom falls—in fact the top of Mount Anglem is snow-clad for only a few weeks in mid-winter. The rainfall at sea-level in Oban amounts to about 65 inches, but it is probably considerably higher among the hills and on the west coast. The summer heat rarely reaches 70° F. and the winter cold 30° F.

On 15 March 1770 Cook sailed round South Cape after having narrowly escaped disaster on the dangerous rocks off Port Pegasus, which he named The Traps.[2] By rounding South Cape Cook had proved the insularity of New Zealand, the northern part of which had been discovered by Tasman 128 years previously and had been assumed to be a northerly projection from a great continent that was believed to exist in the southern hemisphere as a counterpoise for the continental masses of the north. The overlapping silhouettes of the islands of Foveaux Strait led him to suspect that what is now known as Stewart Island was connected with the mainland, and a dotted connection was made on his map. Banks' reference to the country behind South Cape gives an interesting insight into the trend of geological thought at that time:

> By noon we were pretty near the land which was uncommonly barren; the few flat places we saw seemingly produced little or nothing and the rest was all bare rocks which were amazingly full of large veins and patches of some mineral that shone as if the rocks were really paned with glass. What it was

[1] An account of the botany of Stewart Island is given in Cockayne, L., 1909: 'Report on a botanical survey of Stewart Island,' Department of Lands, N.Z.

[2] See R. McNab, 1907: 'Murihiku and the Southern Islands,' Invercargill, William Smith.

> I could not at all guess, but it was certainly some mineral and seemed to argue by its immense abundance a country abounding in minerals where if one may judge from the corresponding latitudes of South America, in all human probability something very valuable might be found.

Both on this voyage and on his second expedition in 1773 Cook refitted in the fjords of the adjacent mainland, which were later also visited by Bligh in 1787, by Malaspina, and by Vancouver, who discovered the Snares Islands, 62 miles south of Stewart Island. With these expeditions the southern shores of New Zealand, although imperfectly explored, had become well known as a convenient haven for refitting on the long ocean voyage to Australia *via* Cape Horn, and it is not surprising that sealers were early attracted to the region. The sealing industry flourished in the early years of the following century when the Bass Strait sealing grounds had become depleted, but in the twenties suffered severe competition from the South Shetlands, and by 1830 the seal trade had collapsed. Sealing was at first confined to the fjords, but later extended to Foveaux Strait and Stewart Island.

Our early knowledge of the southern shores is due mainly to the log of the sealer *Pegasus* and to information collected by the French captain Jules de Blosseville from sealers he met. The story of the voyage of the *Pegasus* in 1808, thirty-nine years after Cook had passed South Cape, is the first record of the existence of Foveaux Strait, although it must have been frequented by sealers several years previously. Foveaux was the Governor of New South Wales. On another voyage in the following year the vessel anchored in Port Pegasus; the island was probably named after William Stewart, the first mate, who made a rough survey of the coastline. Lord's River and Port William were named after Sydney shipowners. Small settlements existed at that time on Codfish Island, at Port William, and at Easy Harbour. With the depletion of the sealing grounds Stewart Island relapsed into obscurity, for the whaling industry that followed and reached its zenith about 1840 was operated mainly from stations on the mainland. In June 1840 British sovereignty was declared at Port Pegasus on a voyage of H.M.S. *Herald* around the coasts to obtain signatures of tribal chiefs to the Treaty of Waitangi. In 1849–50 detailed surveys of the harbours were made from H.M.S. *Acheron*, and these maps are still in use.

In later years the island was exploited for timber and flax, but between 1840 and 1860, when the colonization of New Zealand was proceeding, Stewart Island was neglected. In 1861 gold was discovered in Otago and the feverish excitement that supplanted the tranquil colonization of the previous years extended to Stewart Island, which was scoured by prospectors who had poured into the country from the goldfields of Victoria. Gold was discovered in small quantities on some of the beaches of Stewart Island about 1867, but in 1881 it was found together with cassiterite in more promising amount at Port Pegasus.

Stewart Island has thus experienced the same transient phases of development as the mainland—sealing, whaling, prospecting, saw-milling, and flax-cutting; but the climatic conditions have prevented the establishment of farming, almost the only industry that is contributing permanently to the wealth of New Zealand. Over a century ago, when only the coasts of New

Zealand were exploited, Stewart Island was the most productive centre, but as the island itself has proved unproductive, the seas are once again being exploited: fishing is now the only industry. The fish caught in the adjacent seas is frozen at Oban and at Port Pegasus for the New Zealand and Australian markets, and oysters are dredged from the floor of Foveaux Strait. A refitting base has been established in Paterson Inlet by a Norwegian whaling company operating in the Antarctic.

The erosion level in Stewart Island runs along the uneven roof of an extensive granite mass that lies beneath the surrounding seas and reappears in the Snares Islands and in Fiordland. In Stewart Island the rocks invaded by the granite remain only as small isolated patches on the summits of the highest hills between Port Pegasus and Paterson Inlet. They consist mainly of a dark mica-schist. Tin-tungsten lodes appear in the schist along the crest of the Tin Range, and detrital deposits of cassiterite and wolframite, together with gold and monazite, occur in the streams flowing into Port Pegasus. Paterson Inlet occupies a graben in which a less metamorphosed mica-schist together with marble and quartzite have been let down into the granite. The graben extends westwards and includes the Ruggedy Range and Codfish Island.

In considering the evolution of the drainage, Stewart Island cannot be regarded as a physiographic entity, for the drainage systems are the betrunked headwaters of the rivers of a much larger land-mass. The peaks of Stewart Island may represent the southern end of a pre-Tertiary stripped peneplane discernible among the mountains of Fiordland.[1] The peneplane dips gently southwards from 6000 feet at Lake Wakatipu to 3500 or 4000 feet in southern Fiordland, and, it is presumed, finally reaches 3200 feet in northern Stewart Island and 2500 feet in the south of the island. The peneplaned surface was distorted and fractured during Tertiary and Pleistocene times into a complex series of earth blocks, but the precise location of the dislocations that isolated the Stewart Island block cannot be ascertained, for recent submergence has left exposed only the central portion, and the shape of the sea-floor reflects considerable pre-drowning river erosion and also subsequent marine sedimentation. Nevertheless it is not improbable that the steeply shelving submarine slope to the west of Stewart Island is a tectonic feature, and it is significant that it is in alignment with the Waiau Valley, which was sculptured by the Tertiary movements.

The highlands of Stewart Island lie towards the west coast, and almost all the drainage of the island rises close to the west coast and flows eastwards. This is due in part to the shortening or removal of the western drainage by the relatively rapid cliff-recession of the west coast by the prevailing westerly seas, but it is also an original feature, for the wave-cut bench on the west coast is very narrow. The feature suggests that the initial land-surface of the block from which Stewart Island was carved eastwards (*i.e.* away from the scarp), and that the present drainage of the island is developed from conse-

[1] Andrews, E. C., 1906: "The Ice-flood Hypothesis of the New Zealand Sound Basins," *Journ. Geol.*, vol. xiv, pp. 22–54.

Park, J., 1921: "The Geology and Mineral Resources of Western Southland," *Bull. N.Z. Geol. Surv.*, No. 23.

quent streams that became incised in the sloping surface. The eastward-flowing streams must have been further invigorated by a recrudescence of the eastward tilting evidenced by a well-preserved platform rising evenly from a height of about 300 feet at Port Pegasus to about 1500 feet behind Easy Cove on the west coast (Fig. 1). A similar platform rises from the low coastal hills on the east coast towards the main ridge between Port Pegasus and Paterson Inlet. It is not improbable that the wave-cut bench flanking Table Hill at 1600 feet is an undissected portion of this platform. The strike of the pendants of mica-schist lying in the granite along the ridge between Paterson Inlet and Port Pegasus is approximately east–west. That of the low-grade metamorphic rocks of the Paterson Inlet graben appears to be meridional except where influenced by the bounding fault of the graben.

For the purposes of physiographic discussion, Stewart Island may be considered as a granite island crossed by a band of schists, marbles, and quartzites which are let down into the granite as a graben about 10 miles wide on the west coast and almost tapering out on the east coast (see Folding Map). The ease with which this band of comparatively soft rock is denuded is responsible for the most prominent physiographic feature of the island—the depression

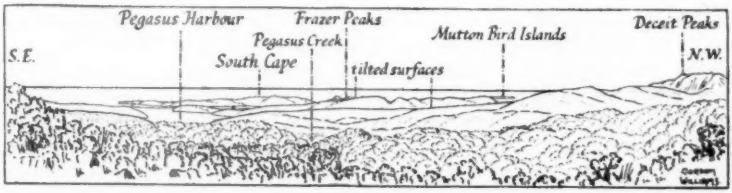


Fig. 1

occupied by Paterson Inlet and the swampy flats that extend to the west coast. It is not clear at what period the graben formed, but as the bounding faults do not form scarps on the landscape it may be concluded that the depression is a fault-line feature only. The infaulted rocks were tapped near the narrow eastern end of the graben by a tributary of a river that flowed eastwards in Foveaux Strait and drained the north-east face of the island. Headward erosion of this tributary developed rapidly in the relatively soft infaulted rocks and ultimately formed an open basin, the shape of which conformed with that of the graben. The local base-level in this basin was determined by the height of the narrow gap in resistant granite at Paterson Inlet heads, through which all drainage of the graben passed. Two large tributaries of the river draining the graben became incised across the southern bounding fault and, invigorated by the low base-level in the graben, captured the westward-flowing drainage of the granite around Rakeahua. One of these tributaries flowed through the narrow gap at the entrance to the south-west arm of Paterson Inlet, and the other through the gap between Rakeahua and the low hills at the north end of Mason Bay. Stream development within the graben is influenced by the meridional structure of the rocks (which is oblique to the direction of the bounding faults) as is shown by the trend of the Ruggedy Range.

The rest of the island is composed of more or less granitic rocks except for some tiny inliers of mica-schist along the main ridge between Paterson Inlet and Port Pegasus. The rounded topography and the irregular drainage patterns of Stewart Island are typical of granite surfaces, for in no other rock-type are factors that could exercise a directional control on the drainage less pronounced. But although apparently massive granite is exposed over the greater part of the island, the existence of roof-pendants indicates that erosion has not penetrated far below the roof of the granite mass, and it is to be expected that denuding agencies would exploit such inequalities in hardness as invariably occur in the border phases of a granite mass. The drainage pattern in the serrated roof would be influenced not only by the structure of the invaded rocks (which is usually reflected in the shape of the roof) but also by variation in the resistance of the rocks of the aureole due to unevenly distributed increments of hard and soft minerals from the batholith. It is probable that the disposition of some of the areas of high relief is an expression of the difficulty with which different parts of the relatively resistant contact aureole were removed. The main ridges between Paterson Inlet and Port Pegasus may owe their relief to such a cause. But the prominent circular masses of granite such as Rakeahua, the Deceit Peaks, and the South Cape mass may perhaps be explained otherwise. The upper margin of a granite mass rising under no directional restraint is not propelled upwards as a body, but as a series of expanding domes separated by zones along which gneissic structure is induced by compression resulting from opposing fluidal motion. Such phenomena may persist to considerable depth. The massive granite in the core of these structural domes would in general be more resistant to erosion than the gneissic periphery, and it is suggested these highland masses may have been isolated in this manner.

With increasing depth in a granite mass the joint grids become wider and show a decreasing tendency towards a pronounced parallelism in favour of any particular trend. Hence they are not in general prominently reflected in the broader physiographic features such as the river patterns: they cannot be recognized in the stream courses of Stewart Island. Inequalities in the resistance of granite to subaerial denudation are introduced by inconstancies in the mineral composition of the rock and by local primary alteration of felspar to clay. These factors are however without pronounced systematic orientation. The open basins in the mid-courses of the Toitoi, Waianiwa, and Kopeka Rivers, in Pegasus Creek, and also in the two basins that are occupied by Pegasus Harbour, may be more satisfactorily explained by denudation of blocks of inferior hardness lying behind more resistant masses than as tectonically depressed areas formed by backward tilting or uplift across antecedent streams; the basins are not aggraded and the streams flowing from them have not recently been rejuvenated. In these flat areas forest cannot exist and only manuka scrub and rushes survive in a deep water-logged clay that may fall under the pedological term "podsol."

It now remains to consider the origin of the detailed features of the granite landscape and to inquire if the accentuated forms found in Stewart Island have been moulded under the present temperate climatic conditions or if they were originally shaped by a rigorous Pleistocene climate and are now

1. Fraser Peaks, 1400 feet, moulded by exfoliation in jointless granite

2. Small weathering features in jointed granite of Fraser Peaks district

3. Mutton Bird Islands and the west coast of Stewart Island

4. Massive exfoliation on Fraser Peaks

5. Tors east of Tin Range formed by removal of intervening block of jointing system

block of jointing system

flaking away more slowly in the normal manner. The reduction of a granite surface is effected by the usual gravitative processes acting on a weathered surface which is loosened partly by chemical decomposition and partly by mechanical disintegration. The reduction of felspar to clay necessitates expansion, which, according to Merrill [1] is the most potent force tending to disrupt a granite surface. It is inconceivable that in the early stages of decomposition when the rock is still coherent, the cumulative effect of the expanding felspar crystals would cause differential movement between the partly decomposed shell and the underlying rock. Expansion of the skin of a convex face would lead to blistering and exfoliation such as may be seen on many rock-faces, but most conspicuously on granite surfaces; for in granite structures along which the strain could be relieved are relatively far apart.

Physical processes that contribute to the disintegration of granite surfaces may be divided into two groups [2]: temperature changes and frost action. Surface disintegration resulting from temperature changes is produced partly by unequal expansion and contraction of the component minerals, and partly by expansion and contraction of the surface relatively to the underlying rock. In a fresh rock surface the disruptive influence of frost depends upon the porosity of the rock and the closeness of the jointing. In fresh granite the porosity is small, but frost action could assume considerable importance in the disintegration of a surface loosened by chemical weathering.

If these processes attack the surfaces of joints that form a coarse grid, bold dome-like features are produced (Plate 1), but with closely meshed joints, smaller features such as typical tors result (Plate 2 and Plate 5). Progressive crumbling and exfoliation of successive shells tend to reduce the projecting more or less rectangular blocks to a hemispherical shape (the top block in the right-hand tors in Plate 1 and Plate 5). The huge domes such as the Fraser Peaks shown in Plate 1 are produced in a similar manner. With a steep profile the loosened slabs are rapidly removed by gravitation, leaving a smooth surface; but if the surface is less steep it becomes littered with loose or semi-detached slabs in various stages of decomposition and disintegration. In less exposed localities the surface is clothed in bush and carpeted with a thick blanket of moss, and the products of decomposition are removed less rapidly than they are formed, and the rock surface becomes buried beneath a deep layer of clayey subsoil which is kept saturated by heavy precipitation. Neither frost nor extremes of heat and cold are characteristic of the Stewart Island climate: strong winds and heavy rainfall are the prevalent features. It seems probable however that the accentuated features such as the Fraser Peaks may have been shaped by the more intense climatic conditions of the Pleistocene period, and that the disintegration of the surfaces produced in that period is now proceeding less rapidly under more equable conditions. The steep

[1] Merrill, G. P., 1895: "Disintegration of the Granitic Rocks of the District of Columbia," *Bull. Geol. Soc. Am.*, vol. vi, pp. 321–32.

[2] Schaffer, R. J., 1932: 'The Weathering of Natural Building Stones,' London, H.M. Stationery Office. The processes that contribute to the disintegration of a natural rock surface must be similar to those that have been found to affect buildings; but on account of the immensely longer period during which the former have been exposed, some processes of small importance to the architect may assume considerable importance in the disintegration of natural rock surfaces.

Pleistocene profile of the higher peaks permits the immediate removal of the weathering debris; and the incessant wind and driving rain prevent the establishment of vegetation beneath which deep weathering, that would normally result from so heavy a rainfall, could proceed. Abrasion by the strong winds cannot be of more than minute significance, for such loose sand as exists is cushioned by water.

The recent submergence, which is so striking a feature of the map, is but one oscillation in a series of land-movements, for wave-cut platforms are preserved in various parts of the island. Remnants of recent raised beaches are recognizable at a height of about 15 feet at the back of many of the embayments of the island. A raised wave-cut bench exists on the northern flanks of Table Hill at an altitude of about 1600 feet, and extends to Pryse Peak. On Table Hill the bench is crossed by streams meandering in narrow gutters cut to the basement through a thin veneer of gravel and plunging from the bench in a series of cascades. Another bench fringes the Tin Range at 650 feet. It is coated with a thin layer of wave-sorted gravel containing cassiterite derived from the tin lodes behind the bench. This bench may perhaps be correlated with an inaccessible platform on the west coast (Plate 3). There are also the well-defined tilted platforms shown on Fig. 1.

By contouring the depths given in the Admiralty Charts the submerged valleys may be followed some distance from the present shore. The amount of submergence can have been no less than 180 feet, which is greater than the depth of Foveaux Strait. As marine sedimentation has not entirely obliterated the drowned river channels, it is probable that the floor of Foveaux Strait has not been greatly raised by sedimentation since submergence. Hence the recent subsidence established the insularity of Stewart Island. It is quite probable however that the island was not connected to the mainland by a ridge of solid rock, but that it was linked by an attenuation of the outwash fan which forms the plains of Southland and which is still exposed as far south as Bluff Hill and embraces Ruapuke Island in a very shallow bank.

The two main streams that rise almost on the west coast and flow into the head of Paterson Inlet are the betrunked tributaries of a river that formerly flowed through the gap now occupied by the entrance to the inlet. The Admiralty soundings are not sufficiently close to enable the course of the river to be traced far to the east. The low-lying marshy flats between Paterson Inlet and Mason Bay support only reeds, flax, tussock, and isolated clumps of manuka scrub, and are crossed by sluggish streams and numerous arcuate swampy strips and ponds representing cut-off meanders. Towards the west coast the swampy country merges into a zone of sand-hills 3 miles wide, behind Mason Bay. The flats are formed by aggradation of the streams draining the highlands on either side consequent upon the rise of base-level initiated by subsidence. The divide between the east and west drainage and also several divides between the dismembered units of the Paterson Inlet river basin were aggraded. As the streams were not diverted along the shorter route to the west coast it may be concluded that, if the sea actually flowed through the region as an island-studded strait, the western entrance to the strait was rapidly blocked by a sand-bar to form Mason Bay. Port Pegasus embraces several submerged inter-tributary divides; aggradation of the longer

reaches of this harbour is insignificant. As the gross amount of drowning is approximately equal in Port Pegasus and Paterson Inlet, and as the extent of wave attack is similar, whilst smaller streams crossing softer rocks flow into Paterson Inlet, there is no reason for supposing that the greater aggradation of Paterson Inlet represents earlier submergence.

The submergence of Stewart Island [1] has been so recent that the original land-forms still dominate the coastal outline. The extent to which the new coastal profile has been attacked after submergence varies from place to place according to the exposure of the locality, the direction of the rock-jointing, and the steepness of the drowned profile. Along the western coast-line, which is exposed to the incessant easterly-directed oceanic roll, high cliffs have formed, the spurs are truncated, and the intervening embayments prograded by the alongshore drift to form the long stretch of sand in Mason Bay, the pocket-beach in Doughboy Bay, and the land-tying of the islets at the south end of Mason Bay. The incision of the small streams reaching the coast elsewhere than in the prograded bays does not keep pace with cliff-recession and they drop from the cliffs as small water-falls. Deep retrogradation of the headlands on a recently submerged coast by a westerly roll is characteristic not only of Stewart Island but also of most of the islands in the southern Pacific and Indian oceans. For instance, in the Auckland Islands the west coast has receded under wave attack to such an extent that the western drainage systems have almost entirely disappeared and the head tributaries of some of the streams that drain east have been diverted to the west. On the east coast the original ridges project as long tongues into the ocean; in general, only small beaches have formed, and the profile is only slightly notched at sea-level. Within the shelter of the harbours the shore-line sculpture is crenulate and the hills plunge with even contour beneath the water with only a slight nip at sea-level. Only small sandy beaches occur within the harbours, but tidal flats formed by stream-borne detritus occur at the head of the longer embayments.

It is not surprising that the unique topographical forms in southern Stewart Island should have led to a general belief that Stewart Island was extensively glaciated in Pleistocene times. Only two references to glaciation in Stewart Island are based on actual field knowledge, and in these, discordant views are expressed on the rôle of ice in moulding the striking scenic features. Petrie [2] believed the remarkable bare domes forming the Fraser Peaks (1400 feet) to be *roches moutonnées*—implying that the greater part of the island was covered by ice during the Pleistocene ice-age. Although Cockayne [3] believed the smooth granite domes were formed by normal subaerial agencies, and thought the small lakes on Mount Anglem (3200 feet) were dammed by morainic material deposited by small valley-head glaciers, he conveyed some uneasiness by stating: "It is more easy to believe that glaciation has been much more

[1] Speight, R., 1909: 'The Subantarctic Islands of New Zealand,' vol. ii, Philosophical Institute of Canterbury.

[2] Petrie, D., 1881: "A Visit to Stewart Island with some Notes on its Flora," *Trans. N.Z. Inst.*, vol. xiii, p. 323.

[3] Cockayne, L., 1909: 'Report on a Botanical Survey of Stewart Island,' Wellington N.Z. Lands and Survey Department.

extensive than that there was at one period a small ice-field on the highest mountain." The writer's observations lead him to believe that the rôle of ice in moulding the present topography of the island was even less than that suggested by Cockayne. He agrees with Cockayne that the Fraser Peaks do not owe their smooth outline to abrasion beneath an ice-sheet; and on account of their low altitude with respect to obviously unglaciated hills in the neighbourhood, and of the convexity of their outline, it is clear they are not glacial horns. It is suggested however that they are abnormal forms in that their bold relief may have been shaped by exfoliation under the more rigorous climatic conditions of the Pleistocene period. The accumulation of talus against the peak in Plate 1 may perhaps be explained by the reduced carrying power of the streams that drain it, consequent upon the diminished precipitation under recent climatic conditions and upon the rise in base-level after the recent submergence.

Two small lakes exist near the summit of Mount Anglem. The larger of these faces north-east and lies in a shallow rock-bound basin backed by rock faces. The overflow is across a small notch in a solid rock-barrage surmounted by angular rubble, and the hollow is only a slight niche in a normal valley-head, leading up to a well-rounded summit. The mountain is composed of granitic rocks, and such processes as rock solution or subaerial etching along contacts between dissimilar rocks cannot have contributed to the formation of the hollows as has been the case with some tarns described by Garwood[1] from Canton Ticino. Nor is it a moraine-dammed lake as are those studied by Marr[2] from Lakeland. It is clear that ice is the only agent of erosion that could have excavated this true rock-basin. The hollow is presumably a corrie scoured out by a small valley-head glacier, and the rubble that surmounts the rock rim was dropped on retreat. Lateral excavation was insignificant; striated surfaces were not found, but their persistence on a granite surface cannot be expected. The smaller lake near the summit of Mount Anglem faces south-east and lies in a pocket in a valley-side. The nature of the barrage was not determined, but the overflow runs in a narrow gutter down the side of the main valley. The lake is backed by a steep face, but very little lateral excavation appears to have occurred. From the general appearance of this lake, and from its existence close to the larger one that is clearly a glacial feature, it may be concluded that it represents an early stage in glacial development. Another small lake appearing below the summit of Mount Allen, the highest point in the southern highlands, is dammed against a steep face of gneiss by a bank of angular rubble. It has been formed behind a landslide that moved over a major joint in the gneiss forming the back of the lake. The lake cannot be ascribed directly to glacial causes. Morainic material was not found in Stewart Island except in association with the small lakes on Mount Anglem. The evidence, then, suggests that the glacial cycle did not develop beyond the *névé* stage in the southern highlands (2500 feet), but that the northern highlands (3200 feet) supported two small valley-head glaciers.

[1] Garwood, E. J., 1906: "The Tarns of the Canton Ticino," *Q.J.G.S.*, vol. lxii, pp. 165–93.

[2] Marr, J. E., 1895: "The Tarns of Lakeland," *Q.J.G.S.*, vol. li, pp. 35–48.

This conclusion is of considerable interest for it gives a datum-line for glaciation in southern New Zealand. The peaks of Stewart Island are so situated that they could not have been affected by ice originating in the high alpine chain of New Zealand; moreover, Park's [1] concept of an Antarctic ice-sheet extending over the South Island has received no support from geologists or botanists. The glaciated forms observed in Stewart Island must, then, be regarded as having been produced by such ice as could form on the Stewart Island mass. But can it be assumed that the present height of Stewart Island is comparable with its altitude in Pleistocene times? It has been shown that several fluctuations in sea-level have occurred, the most recent movement being a subsidence of over 180 feet; and Andrews [2] believes only a "slight" post-glacial subsidence has occurred in Fiordland. As Stewart Island does not seem to have been isolated by any very large post-glacial faults (there appear to be no undissected exposed or submerged fault-scarps in the region) it may be assumed that post-glacial strand movements in Stewart Island have been of an order of magnitude similar to those of the fjords; hence the height at which glacial features were found in Stewart Island (3000 feet) may be used as a rough datum in glacial problems connected with the mountains of Fiordland. The writer considers, then, that in the extreme south of New Zealand, the altitude at which ice could form during the Pleistocene ice age was somewhat higher than that at which the glacial features now stand—possibly of the order of 3500 feet. And as Stewart Island is at the extreme south of New Zealand, all glacial effects found at lower altitudes in New Zealand must have been formed by ice moving from higher regions. It is interesting to note that Speight [3] has described an early U-valley stage of development from the Auckland Islands, which are 5° south of Stewart Island and now reach a height of 2000 feet.[4]

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[1] Park, J.: "The Geology of the Queenstown Subdivision," *Bull. N.Z. Geol. Surv.*, No. 7.

[2] Andrews, E. C., 1906: "The Ice-flood Hypothesis of the New Zealand Sound Basins," *Journ. Geol.*, vol. 14, pp. 22–54.

[3] Speight, R., *ibid.*

[4] The glaciation of the Auckland Islands was less severe than that of North Wales, which is almost on the corresponding latitude.

A HISTORICAL SKETCH OF THE FLUCTUATIONS OF LAKE OSTROVO IN WEST MACEDONIA

MARGARET HASLUCK

LAKE OSTROVO, one of the most beautiful and interesting pieces of water in Europe, lies, orientated NNE. and SSW., in a narrow valley 137 km. west of Salonika by rail. It measures about 17 km. in length, from 3 to 8 km. in breadth, and at its deepest more than 75 m. Its beauty rests, not only in the velvety sheen and varying depth of tones in the water, but also in the shape and colouring of the steep, bare, limestone mountains surrounding it. To the north-west the foothills of Kaimakchalan tower up, in places straight and unbroken almost as a wall, no less than 500 m. above the water, and on the south-east the equally steep and unbroken foothills of Vermion rise 70 m. above the water. On either hand higher ranges appear behind the foothills, those of Kaimakchalan tipped with snow for nearly all the year. In the morning light, which is ethereally clear, the sides of Vermion are inky black, and those of Kaimakchalan a light grey; towards midday a blue haze clouds the summits of Kaimakchalan; and as evening approaches, Vermion seems to draw nearer and its limestone darkens to French grey, while Kaimakchalan, still distant, darkens to slate grey.

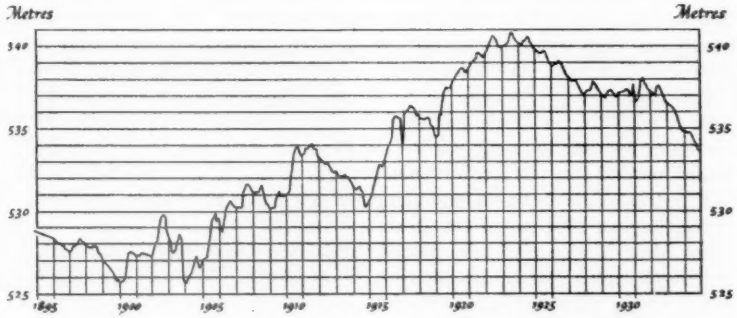
The mountains rise so abruptly from the water's edge that the lake, except at the narrow east and west ends, has no shore. The plain at the west end, stretching southwards for over 20 miles, is featureless and too remote to be often visited by travellers. The little plain at the east end, traversed by both the road and the railway from Salonika to Monastir, is distinguished by a small rock crowned with a broken minaret, the relic of a domed mosque. This rock rises roughly half-way between the village of Ostrovo and the picturesque cape known as Sut Burun; it is, as we shall see, highly important for the history of the lake. Till 1924, when they were removed to Asia Minor as arranged by the Convention between Greece and Turkey for the Exchange of Populations, Turks lived side by side with Bulgars in the village; their places have been taken by Greek refugees from Asia Minor.

The lake has no visible outlet, because it is hemmed in by the mountains, but its surplus water is thought to travel underground to the village of Gougovo, 8 km. away to the east as the crow flies, and more than 50 m. lower in level; it is well known that rivers in the limestone areas of Greece often travel by underground channels (*καταβόθραι* in Modern Greek). At Gougovo the water emerges in the springs of Kourada (Fig. 1), where the River Voda takes its rise. The only overground streams feeding the lake are a few insignificant torrents, of which the most considerable are the Chegan, flowing into it from the north-east, and the Nalbanköi, flowing into it from the south-west; in summer the Chegan dries up altogether, and the Nalbanköi carries very little water. Most curiously, the lake is subject to extreme variations of level. For a number of years, as the graph [1] shows, the water slowly

[1] I am much obliged to the Greek officials and staff of the Salonica–Monastir railway for their help in preparing this graph.

rises, only to subside no less slowly over a period of years. Its rise is not a continuous ascent, but is constantly interrupted by small falls. Its fall is not a continuous descent, but is constantly interrupted by small rises. It is these strange fluctuations which form the subject of the present paper. For their cause is still a mystery, and the first step in any diagnosis is to set out the history of the case. This has already been done for Lake Ostrovo by several writers, notably at the beginning of the twentieth century, but their work needs amplification and some revision. They overlooked certain important authorities, and wrote too early to profit by the information in the graph.

We begin with the story told by the graph. In December 1903 the lake stood at its lowest recorded height, 525·67 m. above the sea, and by a series of alternate advances and retreats reached its highest recorded height, 540·88 m., in June 1923. Though the difference between the two levels, 15·21 m., represents the height of a three-storied house, the water moved up the steep sides of Vermion and Kaimakchalan, and crept over a large area of



the featureless plain at the west end, without sensibly altering the appearance of the landscape. At Ostrovo village, on the contrary, it produced spectacular changes. At first the rock with the minaret was a peninsula to which the villagers walked dryshod from their houses, across a mile of gently sloping, closely cultivated fields, through which the railway ran at heights varying from 530·90 m. to 539·40 m. above sea-level. As the lake rose the cultivated fields were one by one submerged, the peninsula became an island, and the graceful row of poplars, which were such a fine feature in the landscape (Fig. 7), had to be sawn down to save the timber. The water lapped the houses in the village, all the island except the very top and the minaret disappeared from sight, and the railway had twice to be rebuilt on higher ground —first in 1916, when the French and Serbian armies worked night and day to maintain their only means of communication with the battlefields on Mount Kaimakchalan, and again in 1923–26, when the Greek railway authorities rebuilt the line some 16 m. above its original level. After June 1923 the lake began to fall; it left the houses high and dry, bared the old railway lines, and restored the devastated fields to cultivation.

Some of this history is illustrated by the photographs. In Fig. 2, taken

in August 1909 by Professor Kassner[1] from the first railway line, the lake, risen to 530·95 m. above sea-level, is about to convert the peninsula into an island. In Fig. 7, taken by Mons. Boissonnas of Geneva in June 1919, the second railway line is seen sweeping round between the poplars and the village to what was then the station, and the trees are evidently doomed. In a photograph taken from high ground east of the village by Professor Schultze Jena in July 1922[2] when the lake was within half a metre of reaching its maximum height, the fields have completely, and the island almost, vanished from sight. In Fig. 3, taken by myself in August 1923, the high-water mark of the preceding June is seen on the ruined buildings of the first railway station. In Fig. 4, which I took in January 1927, the retreat of the lake has already left the stumps of the poplars visible. In Fig. 8, which I took in January 1934, part of the embankment and the permanent way of the third railway line appears in the lower right-hand corner, the rails of the second line occupy the middle distance, and the lie of the first line can be discerned close to the water's edge.

In the nineteenth century, according to some authorities, the lake rose and fell in the same strange fashion on several occasions. Kassner believes that it reached high water about 1801, 1825, 1836, 1859, 1862, 1875, and 1886. Edmund Naumann concludes that it passed through periods of rise in 1801, 1836, 1858, 1861, 1875, and 1887. We take first the best documented rise, that of 1858–62. In December 1858 the Austrian von Hahn [3] saw the island mosque "swimming in the water." In 1859 the lake rose, so Mrs. Walker [4] heard, several feet farther, but soon retired, so that in August 1860 she saw a large tract of newly bared land being brought under cultivation, and Tozer [5] in September 1861 noted the fresh watermarks on Mount Kaimakchalan. Miss Muir Mackenzie,[6] who passed the lake in June 1863, states that the fall began only a year before her visit. So in 1862 the lake rose to a new high water-level, or, as often in our own time, its fall was interrupted by a temporary rise. Cvijić's information [7] favours the latter alternative; in answer to his inquiries in 1899 local peasants placed the height of the flood between 1858 and 1860: but since illiterate peasants can seldom date accurately, this information is not conclusive. Consequently, it is best to style this flood the high water of 1858–62. There seems no doubt that on this occasion the lake rose higher than it did in 1923. For it is a tradition in the village of Ostrovo that in 1858–62 fish were caught above the third railway line; this line, traversing the village at 546·98 m. above sea-level, is 6·10 m. higher than the high-

[1] Reproduced by Professor Kassner's kind permission from Fig. 2 in his article, "Die Seespiegelschwankungen des Ostrowsees in Makedonien," for which see *Gerlands Beiträge zur Geophysik*, XXXV, Heft 3/4, 1932, pp. 357–69.

[2] Professor Schultze Jena, 'Makedonien,' Plate LXX.

[3] J. G. v. Hahn, "Reise von Belgrad nach Salonik," in *Denkschr. d. phil.-hist. Klasse d. Akad. d. Wiss.*, XI, Vienna, 1861, p. 122.

[4] Mrs. Mary A. Walker, 'Through Macedonia,' p. 127.

[5] H. F. Tozer, 'Highlands of Turkey,' i, 159.

[6] Mackenzie and Irby, 'Travels in the Slavonic Provinces of Turkey,' London, 1877, i, 99.

[7] Johan Cvijić, 'Osnove za Geografiju i Geologiju Makedonije,' iii, 804. I am much obliged to Mrs. Catherine Brown for translating this passage.

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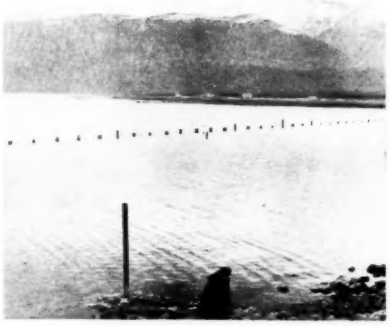
1. Springs of Kourada

2. August 1909: the island a peninsula

3. August 1923: lake-level 540·72 m. June high-water mark (540·88 m.) visible on the station-building



4. January 1927: lake-level 538·12 m. The poplar stumps bared

5. Broken minaret on the island

6. Looking E. to Ostrovo village from the island; bath-house in foreground

7. June 1919: lake-level 537·20 m.

8. January 1934: lake-level 534·91 m.

water mark of 1923. A member of the old-established innkeeper's family, who has lately died, remembered his sister's marriage at the height of the flood; the bridegroom's relatives had to fetch her by boat, because the water was so high that it cut off all access to the inn on foot or horseback; the inn stood near, but higher than, the present railway station in the middle of the village. A field which lies in a bay between the hills immediately north of the village was, according to its present owner, flooded in his grandfather's, but not in his own, time. On the plain north again of these hills the water almost reached the high road to Monastir during the earlier, but not during the later, flood. In the village of Pateli, at the opposite end of the lake, the wine-casks in the cellars of the lowest-situated houses floated in water in 1858–62, but not in 1923.

Since everybody is not prepared to believe what peasants say, it is important to find the above information confirmed by the German archaeologist, Adolf Struck.[1] He found the watermarks seen by Tozer and thought them 18–20 m. above the lake-level of his time. Since this was 527·50 m., the old watermarks were 545·50–547·50 m. above sea-level, and so 5–7 m. above the high water of 1923 (540·88 m.). In September 1899 Cvijić[2] discovered the old shore-line on the island-peninsula, and thought it "about 16 to 18 m. above the then level of the lake"; since this level was 526·02 m., we obtain for the flood of 1858–62 a height of about 542–544 m. Naumann[3] put the watermarks seen by Tozer at 4 m. above the lake-level of his time (1893), and so only about 535·68 m.[4] above the sea. But this figure is impossibly low; at such a height the island mosque is so far from "swimming in the water" that it stands at one end of a considerable island. If however we emend Naumann's text and read 14 instead of 4, we make him put the old watermarks at about 545·68 m., when all is well. At that height the mosque "swims in the water" and Naumann's estimate agrees very fairly with those of Struck, Cvijic, and the peasants.

We now pass to the other occasions in the nineteenth century when the lake is thought to have risen. Kassner,[5] it will be remembered, believes that, apart from 1858–62, it reached *high water* about 1801, 1825, 1836, 1875, and 1886, and Naumann[6] that it was *rising* in 1801, 1836, 1875, and 1887. But the fuller information now available casts doubt on these conclusions. The only information which Kassner has for the high water of 1886 came to

[1] "Die Makedonische Seen," in *Globus*, vol. lxxxiii, no. 14, 1903, p. 215; *cf.* also E. Stouyannakis in the newspaper *Νέα Ἔδεσσα*, 20 August 1921, p. 1. Since Struck found the greatest depth of the lake, then 527·50 m. above sea-level, to be 62·5 m., we know that its greatest depth in 1923 was 75·88 m.

[2] *Loc. cit.*

[3] 'Macedonien,' p. 24.

[4] We do not know the exact height of the lake in Naumann's time, and can only work it out approximately at 531·68 m. from the figures given by Karl Oestreich, "Beiträge zur Geomorphologie von Makedonien," in *Abh. d. Geogr. Ges.*, Vienna, IV, 1902, p. 147. Naumann only states (p. 21) that the lake was low enough for him to go on foot to the ruined mosque.

[5] *Loc. cit.*, p. 362: "Hochwasser war also etwa um 1801, 1825, 1836, 1859, 1862, 1875, 1886."

[6] *Op. cit.*, p. 23: "eine Sichtung der Angaben ergibt folgende Perioden für das Anschwellen des Sees: 1801, 1836, 1858, 1861, 1875, 1887."

Naumann [1] from a certain Captain Dühmig. On 20 January 1887 this officer noted at Ostrovo that "the houses are about 120 paces (100 m.) away from the water's edge. . . . The natives remember the lake's being so high about 20 years ago as to reach the houses. . . . On the long north-east side of the island lie, right on the water, the remains of a bath-house. The foundations of the mosque are 15 m. above the level of the lake. . . . Between the island and the plain the water is about 1 m. deep. The distance between the island and the water's edge amounts to 250 paces (200 m.)."

These notes cannot mean, as Kassner thinks, that Dühmig found the lake at high water. For we have a fixed point in the bath-house. This, according to my measurement, was 0·65 m. deep in water in January 1934, when the lake stood at 534·91 m. above sea-level. So in Dühmig's time, when the bath-house lay "right on the water," the lake cannot have been 1 centimetre more than 534·26 m. above sea-level. Indeed, since the lake-bed slopes rapidly down from the bath-house, it may have been half a metre lower. That is to say, in 1886 the lake was a good 6 m. below the high watermark of 1923. This conclusion is supported by Cvijić.[2] In September 1899, when the lake lay 526·02 m. above the sea, he thought the top of the island "about 23 m." above the water. So in Dühmig's time, when the interval between the water and the top of the island was 15 m., the lake must have lain about 534 m. high. If further proof be needed, in the summer of 1934, when the average height of the lake was 534·27 m., several men of Ostrovo waded across to the island [3]; since the water reached their breast, it was rather deeper than the metre chronicled by Dühmig, and the lake lay by so much the higher than it did in his time.

Kassner has so overlooked the importance of Dühmig's remark about the bath-house that he omits [4] to quote it from Naumann. He may also have been beguiled by Dühmig's first sentence. There the water is said to be only 100 m. from the houses, a figure which suits relatively high water. But this sentence seems to contain a misprint. If the water were so close to the houses, Dühmig's other figures would be wrong; the depth of water cutting off the island would be much more than 1 m., the mosque would be so nearly "swimming" that its foundations would be much less than 15 m. above the water, and, given that the edge of the water was 200 m. from the island, the total distance between houses and island would be only 300 m., a nonsensical estimate. But if we read 1000, or 1100, for 100 m. in Dühmig's first sentence, all his estimates fall into line; above all, the distance between houses and island becomes 1200 or 1300 m., both reasonably accurate figures. Naumann, after retailing Dühmig's evidence, concludes that "since 1887 [the date of Dühmig's visit] the lake has *fallen*, according to my estimate, more than 1·5 m." [5] It is

[1] *Op. cit.*, p. 23.

[2] *Loc. cit.* On p. 805 Cvijić gives a different figure, estimating the interval between the water and the top of the island at 17 m. in October 1909, when the lake was 530·95 m. high. My investigations at the bath-house make me prefer the figure in the text.

[3] Told me at Ostrovo in March 1935.

[4] *Loc. cit.*, p. 361.

[5] *Op. cit.*, p. 23: "seit dem Jahre 1887 ist also der See um mehr als 1 m., meiner Schatzung nach um 1,5 m. gesunken."

therefore surprising to find him in his next paragraph include the year 1887 in his list of the lake's periods of rise (*Anschwellen*). It is true that the lake then stood higher than in 1893, the date of his visit, but he had no guarantee—nor have we—that in 1886 it did not stand still higher.

For the high water of 1875 Kassner relies on two pieces of evidence. The first came from some Austrian geographers.[1] When visiting Lake Ostrovo in 1875 they found it "at high water so swollen that the water-line on the flat northern beach had been displaced several hundred paces and, in consequence (*dadurch*), the peninsula had become an island (100 paces=*c.* 70 m.)."[2] Here, it seems to me, so far as one can understand the rather obscure wording of the German text, the expression "at high water" is not to be taken literally, as Kassner has done. At anything approaching high water the Austrians could not have seen the beach at all; it disappears from sight, as is clear from Fig. 2, long before the lake reaches the high watermark of 1923. They are rather telling us that they found the lake rising and the water-line consequently so displaced that the peninsula had become an island, *i.e.* before this upward movement began, the island was a peninsula as in Naumann's time.[3] The rise impressed the Austrians—naturally enough, since they were from Central Europe—but the natives implied that it was trivial by comparison with the "great flood" (*grosse Überschwemmung*) which, "20–30" years before their visit, sent the water to lap the houses in the village. The Austrians do not tell us from what point the water-line had been displaced, nor how far it had been pushed inshore of the island, so that it is difficult to gauge the height of the lake in their time. But if we make the most generous assumption possible, saying that almost the whole displacement they mention, some 200 m., took place inshore of the peninsula-island, we find that the lake must have been much as it is to-day, and so only some 534 m. above sea-level. On the evidence Naumann is right in saying that the Austrians found the lake in a "period of rise." But he errs in classing this rise with that of 1858–62; the natives warned the Austrians against such an equation. It may be assumed however that if he had had the graph on p. 339 at his disposal, he would have dismissed this rise as no more than a temporary spurt of familiar type.

Kassner's second piece of evidence for the alleged high water of 1875 would hardly exist if Naumann had not fallen a victim to the elasticity of popular chronology. In 1893 the latter was informed at Ostrovo that the water had washed the houses "20–30" years earlier.[4] Since he had exaggerated the rise witnessed by the Austrians, and had forgotten that in 1887 Dühmig also heard of a great flood "about 20 years" earlier, he chose to subtract 20 from 1893. So arriving at 1873, he concluded he had found further proof that 1875 was a "period of rise." If he had only subtracted 30 instead of 20, he would have seen that his information referred, more probably, to the terrible inundation of 1858–62. My view that there was no high water

[1] Naumann, p. 22: "nach damaliger Notiz sei der See bei Hochwasser derart angeschwollen, dass sein nördliches flaches Ufer um mehrere 100 Schritte verschoben, und dadurch die fragliche Halbinsel zur Insel wurde."

[2] Naumann's equation.

[3] Naumann, p. 21.

[4] Naumann, p. 22.

between 1858–62 and 1923 is corroborated by the peasants of Ostrovo. They are positive that the picturesque experiences of 1858–62, which all have the ring of truth, have had no parallel in succeeding years.

As for the year 1836 Tozer wrote[1] in 1861 that "about twenty-five years ago there was a further rise, and all but a small part of the town of Ostrovo was submerged." Grisebach,[2] travelling in 1839, saw "rising from the water a small island with a mosque," and found himself unable to determine the size of the lake "on account of its temporary increase." Naumann therefore classified the year 1836 as a "period of rise" and so far was right; one only doubts his wisdom in putting this rise in the same category as the flood of 1858–62. Kassner inferred from Tozer's statement that there was high water in 1836. He evidently did not think seriously of the "temporary increase," and for Mrs. Walker this increase was part and parcel of the rise that did not culminate until 1858–62. Ever since about 1800, she writes,[3] the lake had "continued gradually to increase." If silence means anything, two more travellers share her view. In 1845, as though the water was some way below the houses, the Russian Grigorovich[4] describes Ostrovo as "a noteworthy village standing above the lake." Hahn[5] states that between 1848–58 the water rose "some *klafter*" (1 *klafter*=1·9 m.), say 6–7 m., and so suggests that in 1848 it was about 538–539 m. above the sea. Neither writer mentions the rise of 1836.[6]

As for the year 1801, "less than a century ago," Tozer writes,[7] "there was no lake in this region, and many towns existed in various parts of the valley; but about sixty years from the present time [1861] the waters rose and overwhelmed the lower part of the valley." He is corroborated by Mrs. Walker, who writes[8] that the lake rose "from some concealed springs about sixty years ago [from 1860]."

Here the first thing to note is that both travellers are certainly wrong in saying that the lake did not exist before 1800. For Dr. Edward Brown[9] saw it in 1669, and Mercator marks it on his map *circa* 1585.[10] In Byzantine times

[1] 'Highlands of Turkey,' i, 159.

[2] Reise durch Rumelien im Jahre 1839, ii, 152.

[3] 'Through Macedonia,' pp. 126–7.

[4] Victor Grigorovich, 'Ocherk Puteshestviya po Evropeiskoi Turtsii,' 2nd ed., p. 93. I have to thank Mrs. Catherine Brown for translating this passage.

[5] *Loc. cit.*

[6] Grisebach's contemporary, A. Viquesnel, who crossed the west end of the lake in 1838, says that the water then reached as far as the village of Moralar (*Mémoires de la Société Géologique de France*, 2nd series, vol. I, pt. ii, 1846, pp. 249, 252). But, since Moralar is more than 600 m. above sea-level, *i.e.* more than 60 m. above the maximum height of the lake, and the ground between it and the lake slopes gradually, the water can never have reached so far. Viquesnel's description of the site (p. 252) suggests that he confused Moralar with Kolartza, just as he confused Kioseler with Kochana. If so, he tells us nothing, for at all times the lake washes the bluff on which Kolartza stands. I am much obliged to Mrs. E. M. L. Douglas for copying out Viquesnel's account, inaccessible to me as I write abroad.

[7] *Loc. cit.*

[8] *Op. cit.*, pp. 126–7.

[9] 'Travels in Hungaria, Servia, Macedonia,' p. 45.

[10] This date is taken from a note pencilled on the copy in the British Archaeological School at Athens.

it is mentioned by the historians Ephraemius[1] (thirteenth century), Pachymeres [2] (thirteenth century), and Cedrenus [3] (eleventh century). In classical times it was known as Lacus Begorrites.[4] It was an ancient folk-legend which Tozer and Mrs. Walker were repeating under the impression that it was recent history. Here is the story which I have heard at Ostrovo. Long ago there was no lake in existence, and cities, tilled fields, and paved roads covered the slopes of the valley. But one evening an old woman forgot to turn off the tap at the spring from which the villagers fetched their water, and when they woke in the morning, they found a new-made lake. Since this was already so deep that they could not find the tap to turn it off, they had to sit by helpless while the lake overwhelmed the cities, fields, and roads. A much fuller version of this story—minus the anachronistic tap, which we owe to the European war—was told to Struck [5] at the beginning of the twentieth century, and a shorter version to Dr. Brown [6] in the seventeenth century; confused versions are also quoted by Cvijić [7] and Grigorovich.[8] This shows that we are dealing with an ancient legend. The inaccuracy of Tozer and Mrs. Walker's dating then becomes intelligible: chronology is notoriously the weakest point in all forms of folk-history. Besides, passing travellers as both were, their information may have come from a single source, the innkeeper of Ostrovo. According to his modern descendants, he had only lately come to Ostrovo from his native village in distant Epirus, and so was unusually likely to confuse his dates.

If we deprive ourselves, as I think we must, of Tozer's and Mrs. Walker's evidence, we have no positive information about the lake's behaviour "about 1800." But we have good negative evidence from Colonel W. Martin Leake.[9] When visiting this neighbourhood in 1806, he went as near the lake as the waterfall of Vladovo, only 15 km. away,[10] but did not think it interesting enough to visit. He says nothing in his book about its having lately risen, and on his map he represents it—no doubt after inquiry—as quite small; no bigger, in Grisebach's phrase,[11] than "about 1 hour long and half as broad;" in the German geographer's time it was already three hours long. The island is not marked on Leake's map, an omission which implies that it was still part of the mainland. The overwhelming of the island mosque also seems considerably later than 1800. Hahn [12] speaks of its dome, which was therefore intact, or nearly so, in 1858, and Mr. Stavros Hatziharisi, a member of the innkeeper's family born in 1886, remembers seeing a few of its roof-timbers still in place. Since building timber is very scarce in this bare countryside, the Turks would hardly have left good roof-beams to rot indefinitely in a

[1] Lines 8595, 8687.
[2] Mich. Paleolog., II, 11.
[3] Hist. Compend., P. 705 A.
[4] Livy, XLII, 53.
[5] *Loc. cit.*, p. 217.
[6] *Loc. cit.*
[7] *Loc. cit.*, p. 804.
[8] *Op. cit.*, p. 94.
[9] 'Northern Greece,' iii, 274–6.
[10] 'Handbook of Macedonia,' pp. 226–8.
[11] *Loc. cit.*
[12] *Op. cit.*, p. 122.

disused building, mosque or not. For that reason it was most probably the rise ending in 1858–62 which put the mosque out of action. We thus have some negative evidence that the lake did not rise seriously "about 1800," and no positive evidence that it did: and so we cannot accept that year, with Naumann, as a period of rise or, with Kassner, as an occasion of high water.

The high water placed by Kassner in 1825 depends solely on his interpretation of an inference by R. Sieger.[1] The latter concluded from Tozer's account that lake Ostrovo rose to its maximum soon after 1800, and again in 1859, but fell again on both occasions. Since these fluctuations correspond to those of lakes Fucino, Van, and Neusiedler, he inferred from analogy with this better-documented triad that lake Ostrovo reached its earlier maximum "not later than 1825."[2] Kassner accepted this inference, and on the strength of it included 1825 as well as 1800 and 1859 in his list. But does he not misinterpret Sieger? The latter was not thinking of three periods of rise, but only of two; the first began "about 1800" as chronicled by Tozer and, unseen by any traveller but detectable by analogy with the other three lakes, reached its culmination "not later than 1825." And so, if Kassner accepts Sieger's inference that there was high water at Ostrovo in 1825, he must also accept his view that there was low water in 1800. It would be better perhaps to discard Sieger's inference about 1825. Its foundations are undermined by the difficulty of taking Tozer's information about 1800 at face value. It is also improbable that the alleged high water, if it had been a reality, would have failed to come to the ears of Grisebach, travelling only fourteen years later and passionately interested in the lake.

This examination of the evidence about the lake's behaviour in the nineteenth century leads us to the conclusion that the lake rose supremely high on only one occasion, 1858–62, that it was high enough in 1839, 1875, and 1887 to turn the peninsula into an island, but probably not much higher, and that at both the beginning and the end[3] of the century, possibly also shortly before 1875, it was low enough for the island to be a peninsula. Otherwise put, its rise in 1800 is improbable, the supposed high water of 1825 rests on a dubious inference, in 1839 there was a "temporary increase," in 1848 the lake-level was probably about 538–539 m., in 1858–62 about 545 m., in 1875 about 534 m., in 1887 not more than 534·26 m., and in 1893 about 531·68 m. The century ended, as the graph shows, with the lake no higher than 525·67 m.

For some centuries before 1800 the lake seems to have remained at a very low level and to have fluctuated, if it fluctuated at all, within narrow limits. This we infer from the existence of the island mosque and still more of the graves found until recently beside it. For it is unthinkable that the Turks, who are no sailors, would have built a mosque to which they had from time to time to row instead of walking. It is also unthinkable that they would have

[1] "Die Schwankungen der hocharmenischen Seen seit 1880," in *Mitt. d. k. k. Geogr. Ges.*, Vienna, 1888, p. 62.

[2] Sieger's text runs: "dagegen vermögen wir den Vorstoss des Sees nach 1825 nicht leicht in unsere Tabelle einzufügen."

[3] Naumann, 'Macedonien,' p. 21; Struck, *loc. cit.*, p. 215.

buried their dead in a spot subject to periodical inundation, when there was plenty of other space available; as is well known, they are so particular about their dead that they never knowingly bury two persons in one grave—not even if the two persons died several centuries apart, or were as intimately connected as a new-born infant and the mother who died in giving it birth.

This suggestion that the lake was comparatively low and harmless for long before 1800, is supported negatively by Colonel Leake. He mentions neither the fluctuations of the lake-level nor the alternations of the island-peninsula. The latter omission is very striking, since a learned footnote displays his interest in the name Ostrovo and its derivation from the Slav word for "island." As for the duration of this presumed low level of the lake, the want of inscriptions and literary records prevents us from knowing when the mosque was built; popular dating is so unsafe that we cannot trust the local tradition that Sultan Selim the Grim (1512–20) was the builder.[1] But we are on sure ground with a tombstone, now lost, but seen by Naumann[2]; it bore the date 1070 of the Muhammadan era (=A.D. 1664). Since the Turks conquered Western Macedonia in A.D. 1388, they had had time enough before digging this grave, if not before building the mosque, to observe the vagaries of the lake. If these vagaries had ever in their experience been as serious as in the nineteenth and twentieth centuries they would have known better than to use the island-peninsula as a place of prayer and burial. If this reasoning is correct, the lake was extremely low from the late fourteenth to the early nineteenth century. In Byzantine days the lake seems to have been, on occasion at least, high enough to make the island a remarkable feature in the landscape. In the thirteenth century Pachymeres [3] describes the village as an "island in a lake," and Cedrenus [4] in the eleventh century, knows it by its Slav name of Ostrovo (island). In those centuries, then, and possibly ever since the slavonicized Bulgars came to Western Macedonia in the eighth or ninth century, the water was high enough to convert the peninsula into an island.

[1] Naumann, 'Macedonien,' p. 21; the tradition still survives.
[2] *Ibid.*
[3] Mich. Paleolog., II, 11; *ἕλιμνον νῆσον.*
[4] Hist. Compend., P. 705 A.

BAND-I-AMIR

MAJOR W. R. HAY

BAND-I-AMIR is the name given to a chain of five small lakes, or more correctly to the dams which form them, situated about lat. 34° 50′ N., long. 67° 12′ E. in the Yakh Walang district of Afghanistan. They lie at an altitude of about 9500 feet stretched out along the valley of a stream which takes its name from them and which after many wanderings in the mountains eventually debouches into the plains of Northern Afghanistan to feed the eighteen canals of the Hijdehnahr district with the water they conserve. The shores of the most important of the lakes, which bears the name of Band-i-Haibat, can be reached by car from Bamian without very much difficulty in fair weather during the summer and autumn. The distance is about 45 miles and the journey takes four hours to perform. Three passes have to be crossed—the Shahidan (9945 feet), the Shibartu (10,235 feet), and the Kham Kotal (11,660 feet). The last of these is difficult to distinguish and is merely the highest of a series of undulations on an elevated plateau, which when we crossed it in August was dotted with the black encampments of nomad Ghilzais. The gradients are nowhere very severe but some very sharp bends have to be negotiated during the ascent of the Shahidan Pass from the eastern side. During wet weather the soft soil in some of the depressions in the hills turns into deep mud and the road becomes impassable, while in winter the whole country is deep in snow. From the plateau described above the road descends sharply down a narrow spur and before long the traveller sees about 1000 feet below him a strip of vivid blue surrounded by tremendous slopes. This is a portion of the Band-i-Zulfiqar, the uppermost and largest of the lakes. It is about 4 miles long. Another portion of it lying broad and open comes into view farther down the road, with trees along its nearer edge, the only ones visible as far as the eye can range. The second of the lakes—the Band-i-Panir—lies immediately below the Band-i-Zulfiqar and is little more than a pond, being only about 150 yards across. The road gradually descends towards the third lake, the Band-i-Haibat, which is about 2 miles long and 500 yards broad. Its sapphire waters blaze like a jewel in the huge expanse of bare hills. Sheer pink cliffs with numerous inlets enclose the upper portion of the lake. Its southern end is open and the water laps over the great dam of natural rock and falls in thin cascades on to a sort of platform 40 feet beneath. This platform, which is partly rock and partly soil, is all covered with a white or pale yellow deposit, presumably of sulphur, and the water trickles over it to form another small lake a mile or so below. This lake which is known as the Band-i-Kambar is merely a shallow pool. The fifth and last lake—the Band-i-Ghulaman—can be seen in the distance below it. It is circular, roughly three-quarters of a mile in diameter, and said to be quite shallow. The lakes are surrounded for a short distance by low undulating country which is bounded on the west by a huge yellow bluff, rising to about 2000 feet above the level of the lakes, composed of some soft substance and scarred along its face by outcrops of solid rock.

It appears to be the same rock which cropping out across the valley has

Band-i-Haibat, looking north

Band-i-Haibat, showing the shrine of Hazrat Ali

Band-i-Haibat

Band-i-Haibat: below the dam

created a series of natural dams and formed these unexpected lakes. The barrier at the end of the Band-i-Haibat itself is a wall of solid rock about 40 feet high at the centre, of no very great thickness at any rate at the top and forming an almost perfect curve. The barrier which encloses the Band-i-Zulfiqar is said to be similar in character. The other three barriers are not so perfect and have only allowed comparatively small quantities of water to collect. The traveller crosses the white platform below the Band-i-Haibat and comes up on the western side of the lake where stands a white shrine sacred to Hazrat Ali, the son-in-law of the Prophet. All round the edge of the lake just below its surface runs a ledge of pure white rock which makes even deeper the intense blue of its waters. Swarms of great yellow fishes swim lazily about, and the whole with the quaint white shrine and the straight pink cliffs produces an impression of something nearer fairyland than anything else in this world that it has been my fortune to see.

Soon after our arrival the local Hazaras began to collect and sat quietly round the shrine watching us. One produced a rope—rather than a line—and caught one or two of the yellow fish—which are known locally as *chush*. I went for a swim but the water was so cold that I did not stay in more than a minute. The lake is locally reputed to be unfathomable. It is said that the Amir Habibullah endeavoured to measure it and failed to find the bottom with 75 yards of rope. Numerous flowers grow round the open southern end of the lake and on the face of the rock barrier where it is not too steep. The Shiah Hazaras of the neighbourhood ascribe a miraculous origin to these dams which are so much stronger than anything human art could build. It is stated that in the days of old the land was ruled by an infidel king called Barbar (from whom the lakes are also sometimes referred to as the Band-i-Barbar), who oppressed his subjects mercilessly. One of them, who had been unable to pay some money demanded by the king and whose wife and children had been imprisoned in consequence, went in search of Hazrat Ali to obtain his assistance. He found him on the road near Haibak. Hazrat Ali told him to tie him up with a rope and take him for sale as a slave to Barbar. He was to demand an extravagant price and when Barbar asked the reason to say that the slave could do anything he was told to. This was done and Barbar demanded that the slave should perform three tasks in one day. The first was to kill the dragon of Bamian, the second to dam the valley where the lakes now lie, and the third to bring him the head of Ali. Ali forthwith slew the dragon of Bamian, and then in a mighty rage hurled the rocks together to form the Band-i-Haibat or the Dam of Wrath. He next as with a sword clove the mountains and created the Band-i-Zulfiqar or the Dam of the Swordsman. He then presented himself before Barbar and told him to load him with every chain he possessed. When he had been thus bound he recited the Muhammadan profession of faith on which Barbar and all his minions fell senseless. He thereupon burst his chains, slew a great part of Barbar's army and compelled Barbar himself to become a Muhammadan.

The Band-i-Panir or the Dam of Cheese was created when a nomad woman presented Hazrat Ali with a cheese. He gave her gold in return and she became the ancestress of the Saiyads who now have the care of his shrine. Strictly speaking the term Band-i-Amir is only applied to the three upper dams

as having been created by the Amir, *i.e.* Hazrat himself. The Band-i-Kambar was built by Kambar, the groom of Hazrat Ali, and the Band-i-Ghulaman or the Dam of the Slaves by the fifty thousand servants of Kambar. Immediately below the rock barrier of the Band-i-Haibat there is a spot where the water wells forth icy cold to form a small pool. The water is crystal clear and the bottom of the pool is of a uniform pale yellow. The spring is called the Ab-i-Safa or the Pure Water and is reputed to have miraculous medicinal properties. The story goes that after Hazrat Ali created the dam it proved so efficient that it let no water pass. The people lower down the valley complained, on which Ali with a blow of his fist made the hole through which the water now springs.

It is perhaps hardly necessary to state that Hazrat Ali never visited Afghanistan and that the legends connecting him with the creation of these purely natural dams have no foundation in history whatever.

MR. ELLSWORTH'S TRANS-ANTARCTIC FLIGHT

VICE-ADMIRAL SIR PERCY DOUGLAS

THE relief of Lincoln Ellsworth and his companion, H. Hollick-Kenyon, by the Royal Research Ship *Discovery II* on January 16 of this year has already been recorded in the Press, but an account of the whole proceedings leading up to the relief and the subsequent return of the ship to Melbourne with Lincoln Ellsworth on board has been made available by the courtesy of the Discovery Committee of the Colonial Office and cannot fail to be of interest.

It will be remembered that Lincoln Ellsworth and H. Hollick-Kenyon took off from Dundee Island in a Northrop aeroplane to fly to Admiral Byrd's base at the Bay of Whales on November 23 with a view of flying over an unknown part of the Antarctic Continent to discover what they might.

The ship *Wyatt Earp*, which was his "base," reported the commencement of the flight, but the last message received from Sir Hubert Wilkins, who was commanding that ship, reported that the last message from Ellsworth's aeroplane was from lat. 75° S. and long. 79° W. plus west—the plus west presumably being an unknown number of minutes of longitude. This was seven or eight hours later in the same day. Thereafter all was silence from Ellsworth, but not so from the Press, and the climax was reached when the Prime Minister of the Commonwealth of Australia telegraphed a suggestion on December 2 to the Secretary of State for Dominion Affairs that regarding the disappearance of Ellsworth and his companion in the Antarctic, the two Governments should take some action towards their rescue, and that the R.R.S. *Discovery II* carrying out whaling investigations in the south should be used for this purpose. The United Kingdom Government agreed in principle and the United States Government were at once asked for all details which might be useful in deciding whether a relief expedition would be practicable; meanwhile a wireless message to the *Discovery II* was sent on 3 December 1935, to proceed with all despatch to Melbourne, so that in the event of a decision to send her to the Bay of Whales the necessary stores could be taken on board with the least possible delay. The New Zealand Government, who are responsible for the administration of the Ross Dependency in which the Bay of Whales is situated, were then consulted, and they agreed to participate in a relief expedition. The *Discovery II* was in a position 59° 30′ S. 99° E. at noon on December 4 and reported that expected arrival at Melbourne would be December 15. She actually arrived at 10.30 on December 13. Information by that time received from the United States Government had led to a decision that a relief expedition would be practicable and on the same day a conference took place between the captain of the *Discovery II* and representatives of the Commonwealth Government with the view of organizing this relief service.

It was decided early in these proceedings that *Discovery II* should proceed to the Bay of Whales, taking with her two aeroplanes generously provided by the Commonwealth Government—one a Moth and the other a Wapiti—to assist in the search. Fortunately no major structural alterations to the ship were necessary, but oil-fuel limitation was a main consideration, and although

the Commonwealth Government gave assurance that they would send an oiler to meet the ship if absolutely necessary, it was arranged that the ship should leave with an upper deck cargo of 100 tons of oil fuel to supplement her ordinary stowage. It was hoped that a whaling factory might be working in the area which the *Discovery II* was to navigate, but inquiries indicated that this would not be the case. When the ship left Melbourne on December 23 at 19.00 she was fully loaded although well above her Plimsoll Mark, but had on board approximately 120 tons of extra cargo which included oil fuel, petrol for the two aeroplanes, six months' extra provisions, sledges and rations with other equipment in the event of sledging parties being found necessary. In addition she carried extra personnel, viz. Flight-Lieut. G. Douglas, Flying Officer A. Murdoch, Sergeants Easterbrooke, Cottee, Reddrop, and Spooner, together with Leading Aircraftsman Gibbs—all of the Royal Australian Air Force.

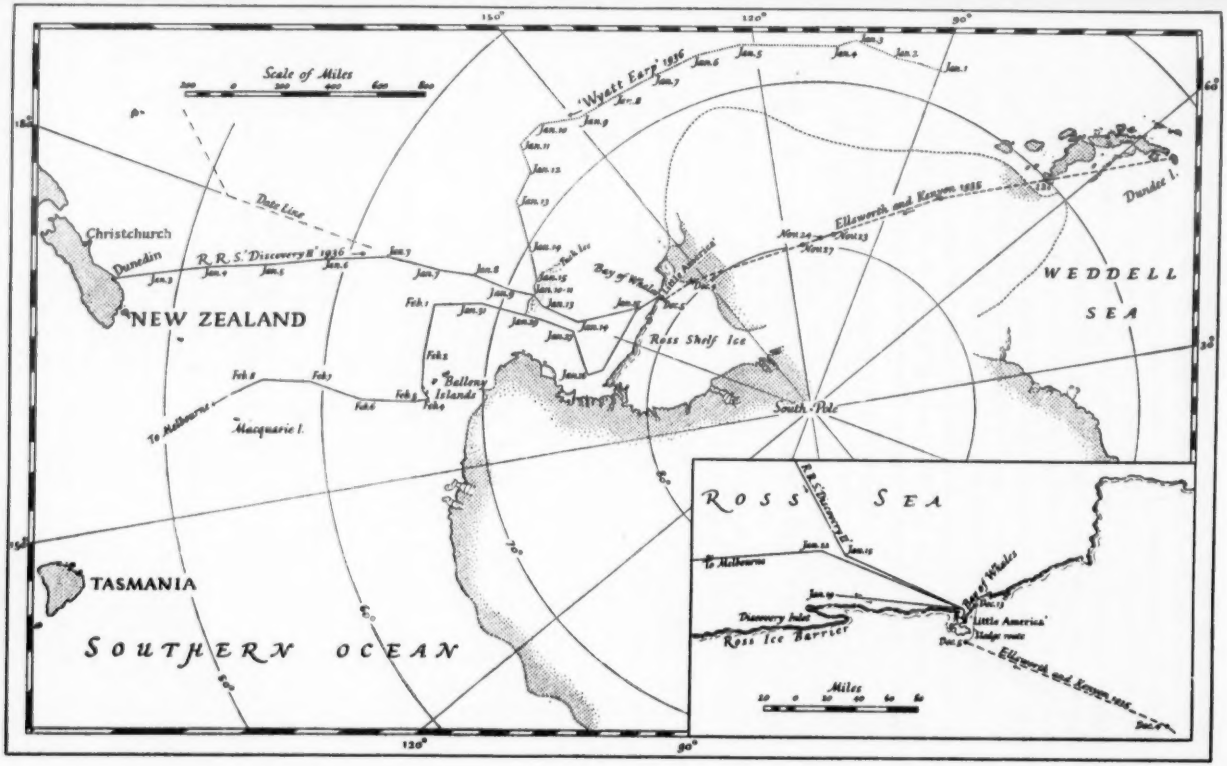
The original intention was for the ship to proceed from Melbourne on a Great Circle Course, south of Macquarie Island and over the reported position of Emerald Island, in order to prove or disprove its existence, and thence to lat. 62° 30′ C., long. 180°, arranging speed so as to arrive in this position about 1 January 1936. Thence, if conditions were suitable, to proceed to the Bay of Whales, the most suitable position to make for being considered as lat. 75° S., long. 180°. However as oil fuel requirements were paramount it was approved that the ship should proceed to Dunedin, N.Z., and not visit the reported position of Emerald Island.

The voyage to Dunedin was uneventful save for constant and heavy head-winds for most part of gale force from the time of leaving Port Phillip till December 29. This meant slow progress owing to the heavy deck cargo and aeroplanes in exposed positions. On this date the ship was two days behind schedule, but the wind then veered and conditions were more favourable, and at 17.00 on December 31, without any further incidents to record, she arrived at Dunedin. Here the ship "topped up" with 82 tons of oil fuel and sailed at 06.00 on 2 January 1936, receiving from Wilkins in the *Wyatt Earp* just before leaving a cable that he hoped to reach 70° S. and 170° W. on January 19, showing that he expected or hoped that Ellsworth had reached his objective in spite of no wireless information from him. It may be remarked that so far as was known Ellsworth and his companion, H. Hollick-Kenyon, had full rations for sixty-one days on taking off on 23 November 1935.

After leaving Dunedin the progress of the *Discovery II* is best given for record purposes in a tabulated form with reports sent by the ship. All positions are at noon, local time, unless otherwise indicated:

3 Jan.	48° 54′ S 171° 53′ E	
4 Jan.	51° 46′ S 173° 16′ E	Head swell and moderate wind but good progress.
5 Jan.	55° 15′ S 175° 00′ E	Established communication with *Wyatt Earp*.
6 Jan.	59° 00′ S 177° 16′ E	
7 Jan.	62° 27′ S 179° 44′ W	
7 Jan.	65° 46′ S 179° 19′ W	Crossed the date line, hence the same date on two days.

The Antarctic Circle was crossed at 17.00 on January 17 with fine weather


Scale of Miles
'Wyatt Earp' 1936
Date Line
Christchurch
Dunedin
R.R.S. 'Discovery II' 1936
NEW ZEALAND
To Melbourne
Macquarie I.
Balleny Islands
Bay of Whales
Little America
Ross Shelf Ice
South Pole
Ellsworth and Kenyon 1935
Dundee I.
WEDDELL SEA
TASMANIA
SOUTHERN OCEAN
ROSS SEA
Discovery Inlet
Ross Ice Barrier
Miles

and northerly winds. The ship's people employed overhauling "Moth" aircraft engine and tried it out, and sledges with emergency rations prepared for the Wapiti aeroplane. Open water, calm weather with a few icebergs.

Of the flying personnel there were but three capable of piloting and navigating aircraft, viz. Flight-Lieut. Douglas, Flying Officer Murdoch, and Sergeant Spooner, the remaining four being aircraft tradesmen. About this time it was arranged that Douglas and Murdoch should man the Wapiti and consideration had to be taken of possible accidents. If the Wapiti was forced to land, wireless communication with the ship might still have been possible and a relief flight by the Moth not necessary, but if communication was severed through a complete crash it would be necessary to send out the Moth, and it was approved, if this was the case, that one of the ship's officers who had volunteered should assist Sergeant Spooner as navigator.

8 Jan. Noon 67° 37′ S 178° 25′ W Light open pack encountered at 18.00 on January 7 but steady and easy progress south was made.

9 Jan. 16.00 70° 19′ S 178° 20′ W Good progress through large open leads being maintained.

10 Jan. Noon 71° 37′ S 177° 42′ W Ice heavier, and leads less open. Ship lying to, awaiting opening.

11 Jan. Noon 71° 37′ S 177° 41′ W Ice conditions improving slightly. Reported that ice was met in 66° 38′ S., but ship now held up 500 miles from Bay of Whales by heavier and more compact floes. Ship was waiting for improved conditions in excellent weather.

12 Jan. Noon 71° 45′ S 178° 04′ W Ice of softer character and more open leads reported. A reconnaissance by the Moth showed open water 40 miles away.

13 Jan. Noon 72° 23′ S 179° 01′ W Ship entered large open lead and making good progress. Moth again out on ice reconnaissance. *Wyatt Earp* reports her position 68° 21′ S. 165° 50′ W.

14 Jan. Noon 74° 46′ S 179° 55′ W Ship reported heavy pack cleared on morning of January 12 in 72° S. 178° W. and open water reached early on January 14 in 73° 30′ S. 179° 30′ W. Flight reconnaissance by Douglas and Murdoch showed the easiest route through the ice. Ship now 320 miles from Bay of Whales with calm weather and clear sea ahead.

15 Jan. Noon 77° 53′ S 169° 00′ W Ship reported expected arrival in Bay of Whales 18.30 on January 15.

She actually arrived at 20.00 on January 15 and one man was sighted on the

shore apparently from the Moth. *Wyatt Earp* was then 420 miles from Bay of Whales.

On January 16 a message was sent to the effect that Ellsworth and Kenyon were both alive and well and a further message dated January 17 informed the Discovery Committee that on first arrival at Bay of Whales an orange-coloured streamer with a tent was observed on the Barrier Face. A rocket was fired from the ship but there was no answer to this. The Moth then flew to Admiral Byrd's old base 5 miles inland, and when she arrived Kenyon emerged and a food parachute with letters was dropped from her.

The ship then landed a relief party which met Kenyon, who had walked towards the Barrier Face, and he arrived on board at 00.55 on January 16. When on board Kenyon reported Ellsworth alive but suffering from a slight cold. The ship's party continued inland to Byrd's base and eventually returned with Ellsworth at 21.37 on the same day, *i.e.* January 16. Ellsworth and Kenyon reported that they had run out of fuel when 20 miles 165 degrees from Byrd's old base, and sledged in. Kenyon was very fit and it was reported that the failure of Ellsworth's wireless was due to a faulty transmitter switch. So ended the relief of these two enterprising airmen, and it was a source of gratification to the Discovery Committee that the result of the search had been so successful and the ship had not been in any way jeopardized.

It was the Committee's desire that *Discovery II* should return from the Bay of Whales as soon as conveniently possible, but not until the *Wyatt Earp* had joined. Pending her arrival *Discovery II* employed her time making scientific investigations along the Barrier Face, and at noon on January 19 she reported her position as 78° 15′ S. 170° W., and added that she was then proceeding to rendezvous with *Wyatt Earp*, and on that evening they met and proceeded in company to the Bay of Whales.

At noon on January 20 *Discovery II* was in Bay of Whales and expected to leave 17.00 on January 21. On January 22 at noon she was making stations towards the north and in 77° 49′ S. 171° W. with Ellsworth on board for passage to Melbourne. Kenyon remained in *Wyatt Earp* to salve Ellsworth's machine, it having been arranged that *Wyatt Earp* should then return to Valparaiso direct and from thence to New York *via* the Panama Canal.

The *Discovery II* continued to make scientific stations till January 25, when she was in 77° 05′ S. 171° 46′ E., and on 26th inst. she proceeded north for Melbourne, her position at noon on that day being 76° 10′ S. 168° 40′ E.

27 Jan.	Noon 74° 44′ S 178° E	
28 Jan.	Noon 73° 14′ S 178° 17′ E	Ship navigating through heavy loose pack.
29 Jan.	Noon 72° 29′ S 178° 25′ E	Same condition, and on this day she reported that *Wyatt Earp* had salved Ellsworth's plane.
30 Jan.	Noon 71° 22′ S 178° 18′ E	Navigating through scattered pack: a pronounced swell.
31 Jan.	Noon 68° 45′ S 177° 43′ E	Cleared pack at 18.00 on January 30 in 70° 53′ S. 178° 49′ E.
1 Feb.	Noon 66° 00′ S 175° 36′ E	
2 Feb.	Noon 66° 00′ S 167° 30′ E	

Finding the Balleny Islands free of pack the ship remained to carry out a brief survey in fine weather, but decided only to stay a short time. Unfortunately fog and snow was experienced.

4 Feb. Noon 66° 34′ S 161° 7′ E Off Balleny Islands.
5 Feb. Noon 65° 45′ S 160° 55′ E Balleny Islands survey abandoned owing to thick weather.
6 Feb. Noon 62° 24′ S 161° 07′ E *Wyatt Earp* reported she had cleared pack and was proceeding to Valparaiso.
7 Feb. Noon 59° 13′ S 163° 00′ E
8 Feb. Noon 56° 25′ S 162° 53′ E Ship passed close to charted position of Emerald Island, minimum depth obtained being 2540 fathoms.
9 Feb. Noon 54° 09′ S 162° 49′ E
10 Feb. Noon 52° 07′ S 160° 30′ E
11 Feb. Noon 50° 13′ S 158° 45′ E Strong north-west gale.
12 Feb. Noon 49° 26′ S 157° 23′ E Ship reported whole westerly gale, and having been hove to for 14 hours but making headway again.
13 Feb. Noon 46° 58′ S 155° 35′ E Weather moderating.
14 Feb. Noon 44° 02′ S 152° 19′ E Ship reported expected to arrive Melbourne 10.00 February 17.
15 Feb. Noon 41° 22′ S 148° 51′ E
16 Feb. Pilot boarded ship off Port Phillip head 16.57.
17 Feb. Ship docked Melbourne at 10.00.

On February 12 it was announced that the American Chargé d'Affaires in London had assured the Secretary of State for Foreign Affairs of the sincere gratitude of the United States Government for the efforts of the United Kingdom, Australian, and New Zealand Governments on behalf of Mr. Ellsworth and Mr. Hollick-Kenyon in the Antarctic. The Chargé d'Affaires said that the effective work of those on board the Royal Research Ship *Discovery II* was deeply appreciated in the United States. The generous assistance given to the airmen by the British Graham Land Expedition was similarly acknowledged.

On February 14 it was intimated that His Majesty the King had been graciously pleased to approve of the appointment of Lieut. Leonard Charles Hill, R.N.R., the Master of the R.R.S. *Discovery II* to be an Officer of the Civil Division of the Order of the British Empire in recognition of his services in connection with the search in the Antarctic for Mr. Lincoln Ellsworth and Mr. Hollick-Kenyon.

It was expected that the *Discovery II* would resume her scientific work after leaving Melbourne on or about March 2.

ADDENDUM: *Note on the construction of the sketch-map illustrating the flight.*

With the consent of the Author the following note is appended:

An account of the flight by Mr. Ellsworth, transmitted from the *Wyatt Earp*, was published in the *Daily Express* of January 20 and 24. It was realized that the radio-communication had failed soon after 4.15 p.m. on November 23;

they flew on until 9.55 when they landed "between Hearst Land and Marie Byrd Land." On the following day, November 24, they took off again but landed after thirty minutes' flying. On November 27 they flew again for fifty minutes, and on landing estimated their position as 650 miles from "Little America" and some 300 miles south of the true coast. There they remained until December 4 when they flew for $3^h\ 55^m$ and came down in 79° 17′ S. 153° 16′ W., 160 miles from their destination. On December 5 they took off again, but at 10.3 a.m. ran out of fuel "while flying to the N. end of Roosevelt Island 16 miles from the Bay of Whales."

The *New York Times* of January 18 gave the "first observation" (presumably the landing on November 23) as 79° 12′ S. 104° 10′ W.; confirmed the above position for the landing on December 4; and gave 78° 45′ S. 163° 36′ W. as the final landing on December 5. The same paper on January 19 gave 79° 58′ S. 114° 15′ W. for the landing on November 27.

The *Star-Sun* (Christchurch N.Z.) for January 20 gave the November 23 and December 5 positions as in the *New York Times* of January 17 but with longitude E. instead of W. The *Age* (Melbourne) and *Argus* (Melbourne) for January 20 gave them correctly.

Finally the *Argus* for January 23 gave 79° 12′ S. 104° 10′ W. for the landing on November 24 (converted to Australian date but evidently November 23 above).

The course of the flight has been plotted from this curiously scattered material. There are indications that the aeroplane was keeping G.M.T., but the times given by the *New York Times* seem to be mostly in U.S. Eastern Time 5^h slow on G.M.T. It would be unprofitable to try disentangling the times given in other accounts.

But the question of dates is more important. The dates for the flight are presumably Greenwich or else Western dates. The *Discovery II*, coming from New Zealand, and intending to return to Melbourne, nevertheless changed date on crossing the 180th meridian, making two consecutive days January 7, as recorded above, and presumably dropping a day between January 22 and January 25. By her reckoning Mr. Ellsworth was received on board on January 16 21.37, and the ship was keeping Standard Time 11^h slow of G.M.T. The Australian papers convert dates about this time but leave hours unchanged: *e.g.* The *Star* for January 17 says that the *Discovery II* arrived in the Bay of Whales at 8 p.m. January 16 (Aust.). What seemed in England to be somewhat slow publication of the news received in London by direct radio is explained by the fact that the ship was keeping time 11^h slow of Greenwich, when one was thinking of her as keeping something like Australian time and date.

The course of the *Wyatt Earp* is plotted from the *New York Times* of January 17.

The sledge route of Messrs. Ellsworth and Hollick-Kenyon is plotted from indications in the *Daily Express* of January 24 and *New York Times* of January 17. They came down on December 5, and seem to have started sledging home on December 11. In the first two days they made 12 miles west and north. On December 13, still making north, they reached the barrier edge, realized that they had overshot the mark, and camped 1 mile back.

Observation on the morning of December 14 showed that they were about 15 miles north of their goal, and sledging back along the barrier edge they reached Little America about December 15 (Western date).

Since the sketch-map was made and the above account written, a brief report of the flight, furnished by Mr. Ellsworth to the Captain of *Discovery II*, has been sent to the Discovery Committee. It confirms the above positions, excepting that for the descent on December 4, for which the longitude is given as 153° 46′ S. The sledge journey started on December 9, not December 11: and the aeroplane *was* keeping Greenwich Civil Time.

ARCTIC GEOLOGY

GEOLOGIE VON SPITZBERGEN, DER BÄRENINSEL, DES KÖNIG KARL- UND FRANZ-JOSEPH-LANDES. By HANS FREBOLD. (Geologie der Erde. Edited by ERICH KRENKEL.) *Berlin: Borntraeger* 1935. 10½×7 *inches;* x+196 *pages; illustrations and maps. M.*21 (*bound*)

GEOLOGIE VON GRÖNLAND. By LAUGE KOCH. (Geologie der Erde. Edited by ERICH KRENKEL.) *Berlin: Borntraeger* 1935. 10½×7 *inches;* viii+160 *pages; diagram and maps. M.*14.80 (*bound*)

It is no light task for a geologist to have to write a complete account of a district when his own field-work has only encompassed a small part of the area concerned. In fact to do it intuition is necessary. In this case however the task should not be as difficult as it might be, for the reason that since the first rough account of the geology of Spitsbergen was made (A. E. Nordenskjøld, 1867), two new accounts have already appeared from workers familiar with the Arctic; these were published by Nathorst in 1910 and O. Nordenskjøld in 1921, the former rich in synthesis and hypothesis, the latter a member of the well-known series "Handbuch der regionalen Geologie" (Heidelberg). Nevertheless there is every justification for a new summary of our knowledge of Spitsbergen; for of the 190 publications given in the bibliography about 80, many of them English, have appeared since the 1921 account.

Dr. Frebold gives a comprehensive description of the stratigraphy of the district, from the pre-Downtonian through the Palaeozoic, Mesozoic, and Tertiary, and so into the Quaternary. Each stratigraphic period is characterized by a short list of its typical flora and fauna, to which a description of the conditions of formation is added. The author is least clear and intelligible in describing the earliest and the most recent of the rich series of formations; in fact there are some misunderstandings and contradictions here. The most complete part of the description deals with the fossil-bearing strata, in which the author is most at home. For each formation the description proceeds from region to region, from south through west to north and east. This procedure gives rise to some tedious repetition, which is perhaps unavoidable. The many illustrations are good, the landscape pictures excellent, and the profiles clearly drawn. Small incongruities, such as illustrations without any explanatory passage in the text (*e.g.* Figs. 9 and 10), or others well set up with labels but without any correspondingly adequate explanation (*e.g.* Fig. 13), do not spoil the book, though they do cause some annoyance. When however description

and text do not agree (*e.g.* Fig. 8: in the text augen-gneiss; in the figure Hekla Hook, which does not correspond with the general map) it is difficult. It is nothing less than extremely confusing when on the general map, which is a kind of index to the text, the reference for "Granite, Gneiss, Schist, etc.," bears the note "pink granite, partly pre-Downtonian"—a state of affairs in itself not impossible, but without closer mention in the text. A greater use of special maps might well have been made, bearing in mind the earlier maps of 1910 and 1921.

A general morphological review is conspicuously absent: perhaps it is not suited to the series "Geologie der Erde," from which this book is a volume. A chapter on the geological history is also lacking; and that at any rate should be the kernel of the book: the series to which the book belongs is not on any account intended to be purely descriptive. The twenty-nine pages on "general formation" are partly based on a hypothesis put forward by Holtedahl in 1925 and partly a recapitulation of matter already presented and simply put the opinions of one investigator against the other. There is no attempt to deal with the tectonic history, especially of the late-Palaeozoic, in a synthetic-systematic way, in spite of the excellent beginning made in this direction by Th. Vogt. Even the final table, in which the second and third columns should change places for logical reasons, is only a repetition. The work concludes with a complete author and place index. The book gives the reader a good idea of the stratigraphy of Spitsbergen and with trouble some knowledge of the geological history can be obtained from it; but the author's personal attitude to the many problems presented remains concealed.

By 1935 Spitsbergen and the neighbouring islands had been the subject of no less than four summaries of the results of geological investigations. But for Greenland, the greatest of the Arctic islands, of nearly continental dimensions, and as much as Spitsbergen the arena of numerous and important expeditions, there had been but one account until the appearance of this treatise appearing in 1935 as another member of the series "Geologie der Erde."

Although they appear in the same series and both deal with Arctic geology, the descriptions of the geology of Spitsbergen and of Greenland are not directly comparable. The first is from the pen of a stratigraphist familiar with only a small part of the region described but well versed in the geological literature of the Arctic. In the case of the second book the author has during the last thirty years obtained a personal insight into geological conditions in Greenland such as none other before or after him has achieved; indeed he has made research into the geological history of Greenland his life's task. It is this contrast of approach which causes the books to differ. The Spitsbergen book puts the results of recent researches on the same footing as older material, already incorporated into the earlier text-books which the new book aims at replacing. The Greenland account however begins where the previous summary (Bøggild, 'Handbuch der regionalen Geologie,' vol. 21, 1917) leaves off, and comes willy nilly to be a summary of the author's own investigations or others made in expeditions under his leadership. To a certain extent it is the author's own 'Stratigraphy of Greenland' (1929) extended and modified, in parts amplified in detail, but with its background the chain of causation and the presentation of the problems.

In consequence of the plan of the book no attempt is made to discuss the regions of Greenland for which no material has become available since 1917. Thus the archaic divisions of the country, by far the largest of all, are only described in outline; and the geology of the Quaternary, the present glaciation, and the morphology of Greenland are not dealt with. The treatise is therefore

primarily restricted to the unstable regions of the north, east, and west coasts; these are discussed in detail with reference to their sedimentation cycles, fossil content, and gradual metamorphosis. The stratigraphical description covers the Precambrian (Grønlandium) and early Palaeozoic first in North and then in East Greenland; in the late Palaeozoic and Mesozoic only East Greenland is dealt with, and the description closes with special sections on the late sediments of West Greenland, the tertiary and the basalt. The second principal division of the book giving the geological development of the country is strongly coloured by the author's own views. This might well be expected, since it is the author's personal contribution to the question which has raised problems and made it necessary to revise older conceptions. Since a number of investigations both in the field and in the laboratory are still far from conclusion, the author has on several occasions had to be satisfied with suggestions which may at first seem to lack adequate justification, but for which with the help of a general geological knowledge evidence can usually be found in some other part of the text. In fact this section is particularly valuable, while it indicates the lines of future researches, as well as throwing some important light on the development of the Caledonian in Europe.

There might well be more illustrations, though perhaps there is reason enough for the absence of a general geological map for a country of which five-sixths of the area is buried under the inland-ice; to understand the place-names one must, as so often, refer to the corresponding geographical maps. In a book planned in this way and marked by a sometimes almost too personal style the lack of an index or even a complete list of references is not especially noticeable.

H. G. BACKLUND

REVIEWS

EUROPE

THROUGH BRACKEN AND HEATHER: Wanderings in the Mystic West. By THOMAS NICOL. *Stirling: Eneas Mackay* 1935. $7\frac{1}{2} \times 5$ *inches;* 206 *pages; illustrations and map.* 5*s*

The book consists of series of articles intended to assist "hikers" in Scotland. The author writes with so much enjoyment of his own experience that he may persuade others to visit the places described, but the book cannot have more than a passing interest, and is in no sense a contribution to the geographical literature of Scotland. The apology with which the preface closes disarms the obvious criticism of the style, which is both verbose and sentimental. G. M.

ANCIENT IRELAND. By R. A. S. MACALISTER. *London: Methuen & Co.* 1935. $7\frac{1}{2} \times 5$ *inches;* xii+308 *pages; illustrations and maps.* 10*s* 6*d*

Professor Macalister's latest work is not, like his 'Archaeology of Ireland,' a text-book, but a survey in which he attempts to reconstruct the political and social life and the history of the various peoples who have inhabited Ireland from the earliest times to A.D. 1600. He has set himself a very difficult task, for the archaeological remains in Ireland, though very numerous and of the highest interest, present many bewildering problems and leave long periods of prehistory unrepresented; but he has his own way of dealing with difficulties, and utilizes every conceivable source of information or suggestion, from the customs of Australian aborigines to the Irish climate. The demoralizing effect of the climate of Ireland upon her inhabitants has greatly depressed Professor Macalister, and causes him to end his book on a note of fatalism.

Apart from the perplexing remains of a solitary Glacial man found in a cave in southern Ireland, the earliest human settlements yet found are in the extreme north-east and quite close to each other, at Larne and Island Magee. Both are Mesolithic, the first Campignian, as might be expected from its proximity to Scotland and through Scotland to Norway; the second, unexpectedly, Asturian. While the author repeats the familiar theory that the earliest Bronze Age inhabitants of Ireland (*c.* 1800 B.C.) were of the Mediterranean race, he identifies them with the Picts, who were subsequently pushed up into northern Ireland and Scotland, and thus answers with skill and insight the old question, Who were the Picts? He calls these people the Halberd Men, from the close resemblance between Spanish and Irish halberds. But when he proceeds to suggest that the mediaeval Irish chronicle 'The Book of Invasions' may contain something like evidence that the bronze-using invaders came from Spain about 1800 B.C., he at once weakens his argument, contradicts his own later conclusions, and arouses distrust in the intelligent reader.

The Bronze Age is here divided, and with a good deal of reason, into two completely independent epochs. Professor Macalister suggests that the Halberd Men were conquered by brachycephalic, bronze-using invaders, whom he calls the Sword Men and believes to have come from England and to have been cognate with the Beaker Folk, who were contemporaries in England of the Halberd Men in Ireland. Further, he makes the Sword Men the introducers of the Gaelic language into Ireland, suggesting that Gaelic was later suppressed in England by the Brythons or Cymry. While this theory has the great merit of explaining the remarkable development in weapons, gold ornaments, and burial mounds which took place in Ireland about 1000 B.C., it is not easily

reconciled with the entire absence of beakers from Ireland. As regards the Gaelic language, the author appears to have invented the theory because he has not been able to find any better way of introducing Gaelic into Ireland. His theory would assign to Gaelic a very long native development in Ireland which is not at all consonant with its classical character. Actually, everything points to the late arrival of that language in Ireland, where it possibly replaced Brythonic. He has however proposed an excellent explanation of the fact that sculptured stones are often found in New Grange and other burial mounds of the Sword Men in places where they were covered or could not be seen. His explanation is that as the tombs of the dead were the only elaborate stone monuments of the early ages, each conqueror despoiled those of his predecessors for his own use.

Professor Macalister subscribes to the current opinion that the Aran Islands, with their enormous stone forts which took many years to build, were the refuge of a fugitive people; but he makes these fugitives the Halberd Men, thereby putting the forts, at least in their original form, back to a Bronze Age date much earlier than any previously assigned to them. It is remarkable that he never mentions the innumerable "cliff-castles" of the Irish, Welsh, and English coasts, which are cognate with some of the Aran forts. He deviates, too, from the standard opinion that the tall, fair-haired invaders who conquered part of Ireland about 350 B.C. with their iron weapons and inaugurated the Iron Age were Gaelic speakers from Celtic north-west Germany, who reached Ireland by way of England, suggesting instead that they were Teutons in speech as well as in blood and came direct from Germany. In support of this he adopts, without acknowledgment, the theory of Borlase, who from a close study of mediaeval Irish chronicles believed that the "Fomorian" invaders of the Iron Age were Pomeranians. As we know that intercourse existed between Ireland and Norway and Denmark from the Bronze Age onwards, Scandinavians would here be preferable to "Pomeranians," and it is more probable that they reached Ireland from Scotland, especially as the "Fomorians" are said to have made their first descents upon the coasts of Donegal and Sligo. In this connection the author might have made a comparison between the gold ship found at Broighter near the north coast of Ireland and a similar ship in the Copenhagen Museum. Instead he puts forward a theory that the Irish ship was connected with phallic worship. His equation of the Irish names of the legendary invaders Heremon and Eber with the modern German names Herrmann and Eber (a boar) is too facile philology to be evidence that these heroes came from Germany. In dealing with the Iron Age, Professor Macalister has discovered a new origin for the Ogham script, which is found only in these islands and had its home in Ireland. He derives it from a Greek alphabet used in Etruria in the sixth century B.C., which the Druids of Gaul imitated, first for sending mute messages with the fingers, and afterwards on stone. The complete absence of Ogham inscriptions in Gaul and their late occurrence in Ireland (*c.* fifth century A.D.) are against this derivation.

The Men of Iron were succeeded by the Men of the Cross and the Builders of Churches. The author is particularly interesting on St. Patrick, bringing evidence to show that he was never a bishop and that he was officially sent, not to convert the Irish, but to combat Palladian Pelagianism in Ireland. He is certainly right in saying that, in spite of all that has been written about the Christian period in Ireland before A.D. 700, that era is still in many respects a dark age to us. He has however dispelled some of the darkness. Indeed, this section and that which follows it, "The Builders of Castles" (the Anglo-Normans), are notably well handled. Yet although many of the archaeological sections reveal the hand of an expert, this book is not to be regarded as a strictly

scientific work. The all-embracing fancy which dominates it and the many moral sermons which the author interpolates show that it is to be regarded as the free expression of Professor Macalister's personal feelings and ideas about ancient —and modern—Ireland, written largely for his own enjoyment. And while many of his theories will be disputed, there is no doubt that he has written a very interesting book, full of curious lore and learning. E. L.

THE CATHEDRALS OF NORMANDY. By JOCELYN PERKINS. *London: Methuen & Co.* 1935. 7½×5 *inches;* xii+316 *pages; illustrations.* 8*s* 6*d*

Those who remember Canon Perkins's little 'Walks in Rouen' will open this book with renewed interest. And there will be no disappointment. Rouen Cathedral naturally receives more detailed treatment than in the 'Walks,' and we are then escorted to Bayeux, Lisieux, Evreux, Coutances, and Sées. The author's method is to open with a detailed historical essay and then to proceed to an artistic appreciation of the building. His advice, that the visitor should first rest quietly inside each church, clearing his mind to absorb the spirit of the place before attempting any detailed examination of the architecture, could not be bettered. A hundred questions may have to be answered before the visit is over, but they can wait. The great essential, as Canon Perkins says, is not to hurry.

The author has a good many acts of vandalism to record, and he can be very trenchant in his criticisms: but there is indeed much to be thankful for—the west front and the first glimpse of the nave at Rouen, the crypt and the Romanesque work at Bayeux, the silver spire of Evreux, the choir at Coutances, the grace and elegance of Our Lady of Sées. One could have wished for some more illustrations, but Canon Perkins has given us so much that it is ungracious to ask for more. M. L.

LIFE AMONG THE LAPPS: On the Spring Trek with the Köngämä Lapps. By SVEN HAGLUND. Translated from the Swedish by WILLIAM SAVAGE. *London: Denis Archer* 1935. 8½×5½ *inches;* 252 *pages; illustrations and sketch-map.* 12*s* 6*d*

This is a racy and spirited record of eight weeks in spring and early summer spent by the writer in accompanying a Lapp family through part of their annual trek. This led from their winter quarters near the Finnish border, in a north-west direction, rising gradually towards the watershed between Norway and Sweden, as the reindeer wandered ever upward in their search for food. Afterwards, partly in company with another family, the west coast was reached.

As one reads the graphic description of life in the tepee, shared by men, women, children, and dogs, one marvels at the adaptability of the traveller who, in so short a time, was able to accommodate himself to the close companionship, human and canine, to the heat and dense smokiness of the atmosphere within, separated only by the blanket-covered birch poles from a temperature of many degrees below zero without; to a floor covered thickly with layers of twigs, difficult to walk about or stand on, but still more difficult to sleep on; to the queer food, consisting chiefly of reindeer stew, washed down with strong sweet coffee; and to the arduous life of toil, unregulated by the usual divisions of time.

All these untried conditions, taken in conjunction with the strangeness of the people, their unknown thoughts and opinions, might have daunted the most adventurous spirit. Yet the author says: "Whenever I want to call anything really pleasant to mind, I always think of my tepee up yonder in virgin Nature, with the life and work of the Lapp village and its jolly chatter around me—peace and work at one and the same time."

The book is enlivened throughout by the most excellent photographs, showing the Lapps in all the varied phases of their life and work. We see portrayed also Lapps of all ages, from the infant—fast-bound in its cradle arms and all, to keep tiny fingers from freezing—to the sixty-seven year old "mountain-mother," who prefers to glide gracefully away on her skis from the too ardent stare of the camera.

We are struck by the animation of the features and the merry laughter on so many faces and grieve to think that a race so sturdy and inured to an arduous lot should perhaps be doomed to extinction.

There are a few obscurities of style and faults in spelling and diction—the former due probably to the difficulty of rendering the Swedish idiom unto English that should be equally racy and idiomatic. These do not however detract from the interest of the work, nor make it the less readable. E. G. W.

AN HISTORICAL GEOGRAPHY OF EUROPE. By GORDON EAST. *London: Methuen & Co.* 1935. 9×5½ *inches;* xx+480 *pages; maps.* 15*s*

The function of historical geography has always been very loosely defined. The subject has been made to include such diverse branches of knowledge as the history of geographical discovery and exploration, the history of maps and surveying instruments, the history of the changes of boundaries of states, and even the general influence of environment on the course of history. A few historians are still inclined to believe that the proper purpose of the subject is to record the exact geographical extent of states and nations at different periods of history. The revival of geography as an academic subject in this country is a comparatively recent event, and it has been followed by a reconsideration of the purpose of historical geography. Geographers have come to a general agreement that historical geography should devote itself to a reconstruction of the physical and human geography of past periods. The delimitation of the function of the subject has been aided by the work of many historians, notably by Professor F. J. Haverfield. It is unfortunate that Mr. East should refer to this great pioneer in historical geography in terms which might be considered disparaging, in the first sentence of his preface. In recent years the new view of historical geography as a subject has been welcomed by historians, and they have in fact made far greater contributions to its development than geographers. Nevertheless, although the discussions on the purpose of the subject have been interminable, the actual work accomplished has not been very large. Mr. East has now attempted to apply the modern conception of historical geography to the whole of Europe. Professor E. A. Freeman's famous work, 'The Historical Geography of Europe,' which first appeared in 1881, is entirely devoted to the changes in names and size of states, and is still a useful work of reference. Mr. East has now given us something more than the bare bones which can be obtained from Freeman's book. He has quite rightly begun his book with the Roman Empire; the earlier periods must be left mainly to the archaeologists. He brings his consideration down as far as the year 1870, and deals with the whole of Europe, except the British Isles. It is known that a work on the historical geography of England by a number of geographers is at present in preparation. In any case Mr. East could scarcely do justice to the British Isles in the limited space at his disposal. Within the dates described Mr. East has endeavoured to construct what he and other geographers rather oddly define as "cross-sections" of the past. The task is tremendous, but Mr. East frankly admits that his treatment is selective and not comprehensive.

The book is divided into three parts, the first of which deals with "The Geography of Settlement in Europe" from the period of the Roman Empire

until late mediaeval times. Many problems of rural settlement and the origin of towns are discussed. The second part, "The Political Geography of Europe," deals with the rise of modern states such as France, Russia, Germany, and includes interesting chapters on "The Byzantine Empire" and "Arab Europe in the Middle Ages." It will be remembered that Freeman wrote four volumes on the history of Sicily and Mr. East gives a separate chapter to Sicily as an example "of the changes in human geography which correspond to the vicissitudes of history" (p. 277). The third part of the book is concerned with "the Economic Geography of Europe," and describes the Mediterranean and the Baltic regions during the Middle Ages, before giving a summary account of the influence of the discoveries of the sixteenth and seventeenth centuries on the commerce and trade-routes of western Europe. An instructive chapter on "The Danube Route-Way" is followed by chapters on "Europe in the Eighteenth Century" and "Europe in the Railway Age."

In the opinion of the reviewer the division of the book into the three sections described is not entirely satisfactory, partly because it involves a certain amount of repetition. Further, the complete geographical pictures of Europe at each period have not been sharply defined. The object of the author, which is defined on the jacket as the reconstruction "in the light of historical knowledge of the human geography of Europe at successive periods," is almost entirely defeated by the rigid division into three parts which has been adopted. Throughout the book the author tends to regard the subject from the point of view of an historian rather than that of a geographer. It is clear from his very interesting "Conclusion" that he considers the study of the natural region as somewhat futile, at any rate in the field of historical geography; this opinion is obviously that of an historian. Further, Mr. East stresses what he calls "the evolutionary aspect of geography" (p. 437). It would seem to the reviewer that historical geography will not flourish until this idea is put into the background. There is some evidence in this book that a new geographical jargon is developing. It is to be hoped that phrases like "the town is a phenomenon of the cultural landscape" (p. 108) will not pass into the ordinary speech of historical geographers.

Commendable features of this book are the maps and the very full references. A bibliography which covers more than twenty pages will be of real assistance to the serious reader. Mr. East has carried out an interesting experiment and has produced a book that will be of great value, especially to university students, who have hitherto had to rely entirely on lectures for this kind of material. It is very desirable however that future work in historical geography should confine itself either to smaller regions than the whole of Europe or to shorter periods of historical time. Nevertheless Mr. East must be congratulated not only for his courage in attempting an immense task but also for producing such a creditable result. E. W. G.

LANDESKUNDE VON DEUTSCHLAND. Edited by N. KREBS. Band I. Der Nordwesten. By HANS SCHREPFER. *Leipzig: B. G. Teubner* 1935. 9×6 *inches;* viii+280 *pages; illustrations and maps. M.*9 (*M.*7.95 *unbound*)

This is a text-book which will be welcomed by every University student making a special study of Germany. It is reasonably short, though it actually contains more material than many a bulkier volume, it is printed in pleasant Roman type, it is illustrated with many photographs giving most seductive glimpses of the landscape, and moreover it contains an excellent bibliography of over seven hundred references, so that any particular line of inquiry can easily be followed up.

The first half of the book deals with north-west Germany as a whole, under

such headings as relief and morphology, climate and vegetation, hydrography, settlement during Roman and pre-Roman times, etc., while the second half contains a detailed description of the various natural regions. The number of pages devoted to what the author calls *Anthropogeographie* is interesting in view of the scanty space allotted to this study in most English text-books of geography. Dr. Schrepfer not only discusses the types of houses and villages, the development of towns, and the distribution of population, but also deals with the whole question of human settlement in the area from late palaeolithic times down to the present day. It is remarkable what a large number of aspects of this settlement the author has been able to treat in a comparatively small space and what illumination he is often able to throw on controversial matters. Among the many questions touched upon are the problem of the hiatus between the palaeolithic and neolithic cultures, the significance of the *weiler* termination in place-names, the influence of the early Slavonic invasions west of the Elbe, and the problem of the original vegetation of the heathlands. One of the most interesting sections deals with the psychological characteristics of the various peoples of north-west Germany, in which the author comes to the conclusion that these characteristics are not a heritage from ancient tribal days but are a development of recent times.

The descriptions of the various natural regions have the vividness and intimacy due to close first-hand knowledge. If the author occasionally waxes lyrical, the nature of the country with its long historical and literary associations may be put forward in excuse. Less excusable is the absence of an index, a most lamentable sin of omission in a book of this kind. The author might also have provided more diagrams, especially morphological ones. Some of the dialectal words and expressions of this "low-German" area may cause trouble to English students, and there are a number of traps for the unwary in the shape of misprints, *e.g. gesamtertages* instead of *gesamtertrages*, in a heading on p. 108. On the whole however the book is excellently written and arranged, and if only it had an index it would undoubtedly be classed as indispensable. M. R. M.

SOVIET GEOGRAPHY: the New Industrial and Economic Distributions of the U.S.S.R. By N. MIKHAYLOV. With a foreword by the Rt. Hon. Sir HALFORD J. MACKINDER. *London: Methuen & Co.* 1935. 9×5½ *inches;* xviii+232 *pages; maps and diagrams.* 10*s* 6*d*

No geographer needs to be told of the extreme difficulty of obtaining up-to-date and reliable information on the economic geography of Soviet Russia. The more spectacular developments such as the construction of the White Sea Canal or the completion of the Turk-Sib Railway become known through the medium of the daily or periodic press; official statistics designed to prove progress under the Five Year Plans have been widely published, but, until the appearance of this book, little had been published in the languages of western Europe regarding the changing economic geography of Russia as a whole. The author is a lecturer in the Moscow Stalin Institute of Transport Engineers and has had access to sources of information not available to foreigners. Amazing progress has been made in Russia in so many directions that it is almost incredible that Russians should not appreciate the value of a sober statement of that progress as the most efficient means of spreading knowledge and understanding of their work. Instead there is almost inevitably a blatant propaganda through extravagant statements and a complete ignoring of any preliminary work under the old régime. The present book suffers from both these defects and must therefore be read with care; nevertheless it must be described as indispensable to all geographers—and indeed to all who seek to understand modern Russia.

In the early chapters the results of recent exploration are shown—most notable are the discovery of vast coal reserves in Asia and the Far North, the discovery of a line of oilfields along the flanks of the Urals and of huge new resources of iron ore. The later chapters deal with the changing distribution of agriculture and industry and consequently of population and transport. Whilst it is well known that the First Five Year Plan (1928–32) and Second Five Year Plan (1933–37) aim at the industrialization of Russia, it is not always appreciated that they aim also at the creation of new industrial areas, widely separated, to serve local needs in a country where vast distances are obstacles to progress. These new areas are clearly described. L. D. S.

ASIA

AFGHAN JOURNEY. By BEN JAMES. *London: Jonathan Cape* 1935. 8×5½ *inches; 286 pages; illustrations and sketch-map.* 10*s* 6*d*

Mr. James travelled through Russia to reach Tabriz and had the usual difficulty of all inexperienced travellers in Russia with roubles. At length he passed from Armenia to Persia and all those of his readers who have travelled in those parts will appreciate Mr. James' position: he had no bedding of any kind of his own.

The book as a whole is of very little geographical interest or importance. From Tabriz Mr. James followed the well-beaten track to Tehran and Mashad. Thence he found further progress towards Afghanistan difficult; consequently he never went to Herat and missed the most interesting city in Afghanistan. He proceeded therefore to Baluchistan and eventually entered Afghanistan from Quetta. As he crossed the frontier Mr. James subscribed to that doctrine of which Americans are so fond: that the British in India believe Afghanistan to be a forbidden and dangerous country. Mr. James went from Kandahar to Kabul and interviewed many of the notables there.

In the main, his observations on this latter part of the journey are fleeting impressions with a leavening of knowledge culled from the *Gazetteer of India*. The last part of the book is devoted to an imaginative reconstruction of the last ten years in Afghan history of the type made popular by André Maurois and Emil Ludwig; but it must be confessed that Mr. James is neither so nearly accurate or so entertaining as those protagonists of "colourful" history.

B. E. M. G.

AFRICA

HOLIDAY IN MOROCCO. By ELEANOR RIGO DE' RIGHI. *London: G. T. Foulis & Co.* (1935). 7½×5 *inches; 192 pages; illustrations, sketch-maps and plans.* 5*s*

This is neither a book of travel nor a guide-book. Rather is it a somewhat disconnected series of notes consisting of personal impressions; general information regarding hotels, communications, routes, sport, flora and fauna, clothing, food, etc.; historical facts drawn largely from the authoritative works of Mr. Budgett Meakin; advice as to sights to be seen in the best-known towns in the International, French, and Spanish zones, and short lives of such notable people as Raisuli, Ibn Batuta, and Her Highness the Shareefa of Wazzán, to whom the book is dedicated. The plans of Meknes, Rabat Salli, Fez, and Marrakesh give only a general idea of the towns, while the photographs illustrate the people and the scenery, but apparently carry one farther afield than the text or the authoress, such places as Tinghirt and Skoura for instance, of which there are snapshots, not being found in the index. The authoress's aim is however to tell briefly those things which she would have been glad to know before her arrival in Morocco. E. W. N.

NORTH AMERICA

TRADE AND TRAVEL AROUND THE SOUTHERN APPALACHIANS BEFORE 1830. By RANDLE BOND TRUETT. *Chapel Hill: The University of North Carolina Press* [*London: Oxford University Press*] 1935. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xii + 192 *pages; illustrations and maps.* 11*s* 6*d*

The westward migration of the American people has been the theme of many writers, but one phase of this movement has hitherto been largely neglected. Few authors have "interested themselves in the section known as the Old Southwest, and in particular the route south of the mountains into this area." Mr. Truett has given us an account of the westward movement, in so far as it concerns the region now included in the states of Georgia, Alabama, Mississippi, and Louisiana, in other words the country which lies south of the Appalachians. The author traces the history of communications in this area from the time of the Indian trails up to the year 1830, when conditions were changed by the introduction of the railroad. The treatment is more geographical than is sometimes adopted by historians, and historical geographers will find much interesting material in this short monograph. The origin and growth of towns such as Savannah, Augusta, Mobile, and Pensacola, as here described, are of especial value. In addition to the history of the actual routes and the development of post roads, Mr. Truett has collected a mass of descriptive information about the actual life of the traveller in this region, of the inns and taverns, and of the development and improvement of the modes of transport. The book is very well documented, and contains a full bibliography and valuable appendices concerning the exports from southern ports between 1790 and 1830. The illustrations are chosen from old books, but the only maps, also reproductions of contemporary maps, are not very clearly printed, and it seems a pity that some more modern sketch-maps were not included. The author concludes his book by asserting that "it was the relative ease of travel along the fall line route, around the southern end of the Appalachian Mountains, that stimulated movement into the lower South, enabling the southern territories to achieve statehood in rapid succession." The book is a useful addition to the history of American westward expansion. E. W. G.

ROMANCE OF THE AMERICAN MAP. By ESSE V. HATHAWAY. *New York: Whittlesey House* (*London: McGraw-Hill*) 1934. 9 × 6 *inches;* x + 316 *pages; illustrations and sketch-maps* (by HAROLD BREUL). 10*s* 6*d*

This book is a popular account of the exploration of North America. The author has endeavoured to tell the story of the unveiling of the geographical features of the continent during the past four hundred years. The history of American explorations is treated as a series of episodes. The book begins with three chapters on Spanish explorers, including Ponce de Leon, de Soto, and Coronado. A chapter called "Nosing along the Atlantic" includes accounts of the work of the Cabots. Further chapters deal with Drake, Hudson, John Smith, and the French explorers. "Angling up through the Northwest" is the title of a chapter mainly devoted to a long description of Lewis and Clark's journey, and the concluding chapter, "Trails West," concerns itself with Smith Ashley and Frémont. A brief mention of J. W. Powell's journey in the Colorado valley in 1869 brings the book to a close. The book contains some pictorial maps, but there are no references to other works or to any sources upon which the author has drawn. The style in which the book is written may be illustrated by the following extract (p. 83): "By the close of 1525, therefore, the eastern coast of Uncle Sam's present dominions was already fairly well-known to men in Spain,

Portugal, England, and probably France. And known not because men had cared one whit about that coast, but because they had cared mightily to follow hither and yon any receding gleam which promised to lead them on and into a channel ending in the far-famed lands of the great Kubla Khan." E. W. G.

CENTRAL AND SOUTH AMERICA

MORE PROFIT THAN GOLD. By JOAN ARBUTHNOT. *London: Jonathan Cape* 1935. 8×5½ *inches;* 288 *pages; illustrations and route-maps.* 10*s* 6*d*

This is an amusing story of an unsuccessful trek for gold in British Guiana starting inland from Morawhanna. The party consisted of three women and two men, and a varied assortment of Indian, Negro, and half-caste camp-followers. The book is mostly in diary form, and the ups and downs of the expedition are all told with a great sense of humour, which it cannot always have been easy to preserve. There are interesting tales of snake-charming and although the authoress makes light of all the alarming things that happened to her and her companions, it is impossible not to see, beneath all the jokes and the sang-froid, an extremely brave and adventurous woman. Miss Arbuthnot's reading in the forest on the Venezuelan–British Guiana border was Marcel Proust. M. C.

POLAR REGIONS

ARCTIC TRADER: An Account of Twenty Years with the Hudson's Bay Company. By PHILIP H. GODSELL. *London: Putnam* 1935. 9×5½ *inches;* xiv+304 *pages; illustrations.* 10*s* 6*d*

Comparatively little has been written of life in the service of the Hudson's Bay Company since the time of R. M. Ballantyne. Mr. Philip Godsell, a junior officer in the Company's Fur Trade Department, has lived and traded for twenty years among the Indians and Eskimo of the Canadian hinterland, and his pages can be recommended for their interest not only to students of the economy of the north, but to all who are likely to be refreshed by the account of an unusual and adventurous career.

A great chartered company operating in a dominion lends itself, by its very being, to a certain measure of irresponsible criticism. There could be no more unintentionally convincing rejoinder than this simple account of life in a service which has great traditions towards the natives and which has established a wise, spartan, yet generous regime over their livelihood.

If in trespassing into matters of higher fur trade policy the author occasionally finds himself out of his depth, this is merely symptomatic of the jealously conservative regard towards the traditions of a service inaugurated in 1670: a fine service which has lost nothing in prestige in Mr. Godsell's autobiography. G. B.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

SCENERY AND THE SENSE OF SIGHT. By VAUGHAN CORNISH. *Cambridge: University Press* 1935. 8½×5½ *inches;* xii+110 *pages; illustrations.* 7*s* 6*d*

When scenery began to engage the attention of the intelligent English public about one hundred and fifty years ago tourists' maps were compiled of scenes of beauty such as the Lake District "showing all the stations." The stations were not traffic centres but points of view from which leaders of the new fashion in taste had decided that the prospects were pleasing or austere or it might be even horrid. The faithful tourist placed himself at the appointed spots and

learned from his guide-book the exact sentiments which the scene should awaken in his mind. What these early votaries ignorantly worshipped, that Dr. Vaughan Cornish now declares with full knowledge derived not only from certain of our own poets but also from the new revelation of Nature through science.

Dr. Cornish has succeeded in the extremely difficult task of examining the sources of natural beauty as expressed in scenery, taking account of the various elements physical and aesthetic which together constitute the appeal of scenery to human emotion. He shows how the impression produced by scenery depends not only on the form, colour, and grouping of the natural features; but largely on what he happily terms the "unconscious habit of the eye" in restricting or enlarging the field of view so as to alter the apparent magnitude of the object seen. He shows too how the harmonious or the distracting grouping of the forms of a landscape may be governed by the relation to them of clouds, the incidence of lighting, or even the displacement of the plane to which the eye refers the picture in consequence of the apparent slope of the foreground due to the angle from which it is viewed.

If these were merely happy guesses from the general principles of science and art the book might be relegated to the category of paradoxes, and taken as matter for pleasant controversy. But every conclusion is in fact based on definite observations set out with precision from notes made at the time and in the place where each particular effect was seen. The places are widely scattered over all the lands and seas through which the author's wide travels have led him. The little book with its graceful pencil drawings enforces the value of careful non-instrumental observations and the occasional superiority over photography of skilful sketches, presenting scenery as it strikes a sensitive mind through a trained eye. H. R. M.

VERGLEICHENDE LÄNDERKUNDE. By ALFRED HETTNER. III. Band. Die Gewässer des Festlandes. Die Klimate der Erde. *Leipzig and Berlin: B. G. Teubner* 1934. 7×5 *inches; 202 pages; illustrations and maps*

The first part of this third volume of Hettner's extensive work on the waters of the continents gives a good account of rivers, lakes, firn, and glaciers, together with a clear exposition of the theories which have been advanced to explain morphological features. The latter are illustrated by some really fine photographs which greatly enhance the educational value of the book.

The second part on the climates of the Earth incorporates a good deal of the author's own investigations. The chapter on mathematical climate includes several useful diagrams respecting the income of solar radiation and the length of the day at various seasons in different latitudes. The description of regional climate which follows the exposition of general principles is of necessity highly condensed; but in making generalized descriptions of local conditions the author appears to have exercised great care in his selection of words, so as to allow for unusual weather experiences.

He criticizes Köppen's system of classification of climates, to which a considerable amount of space is devoted, yet considers some form of classification necessary. With this contention the reviewer entirely disagrees. L. C. W. B.

VERGLEICHENDE LÄNDERKUNDE. By ALFRED HETTNER. IV. Band. Die Pflanzenwelt. Die Tierwelt. Die Menschheit. Die Erdräume. *Leipzig: B. G. Teubner* 1935. $9\frac{1}{2}\times6\frac{1}{2}$ *inches;* x+348 *pages; maps and illustrations. M.*9.75. *Presented*

This fourth part brings to a close Professor Hettner's comprehensive work on what he has called comparative geography. It would be profitless to discuss

whether, as some critics have urged, "general geography" would not have been a more fitting title. If a detailed comparative study of the natural regions of the world does not find a prominent place herein, at least the general principles and innumerable suggestions for such a study are provided. The various sections are clearly written and logically ordered, and treated in such a way that they provide a concise view of the historical development of the subject, to which the author's own contributions are deftly welded. A feature of the work is the emphasis laid upon the importance of appreciating the time factor in arriving at an understanding of the present natural distributions: indeed, it might be argued that rather too much space has been given to this aspect, at the expense of detailed consideration of the present conditions.

Two-thirds of this part is given up to the treatment of the geography of plants and animals: the majority of the remaining matter deals with man; and it concludes with a brief summary of the fundamentals and their interaction to produce the surface features of the world as it is seen to-day, this being perhaps the justification for the "comparative" epithet of the title. The attention given to plant geography is certainly larger than usual in works of this kind, but, as will be seen later, there is justification for this from the author's point of view. He brings out very clearly the effect of changing environment from geological times downwards upon the present distribution of plant life, the development of plant physiognomy, the effect of seasonal changes, and finally, the share of man in altering the balance of nature.

The section on man is confessedly rather summary, being apparently merely the outlines of a further work. It aims at treating man at once as a constituent part of the natural regions and as an active force in their present character. It is the necessity for considering this transformative element which naturally prevents this section from assuming the neat shape of that on plant geography, and tends to introduce generalizations rather than concrete examples. He discusses the idea of race very cautiously, claiming that many of the characteristics of human communities are to be attributed to cultural rather than racial differences. Cultural differences again are largely attributed to varying environments, hence the importance and space given by him to the description of the natural phenomena. He is aware of course of the uncertainties introduced by psychological factors, but dismisses them by a reference to the obscurity surrounding the relation between psychological and physical characteristics. So long as this obscurity exists, it seems rather dangerous to consider races as being climatic varieties of mankind. G. R. C.

WHY THE WEATHER? By CHARLES FRANKLIN BROOKS; with the collaboration of ELEANOR STABLER BROOKS and JOHN NELSON. (Second edition, revised and enlarged.) *London: Chapman and Hall* 1935. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xviii + 296 *pages; illustrations.* 10*s* 6*d*

This book is in the main to be classified as an explanatory description of the various phenomena of the weather, as observed in particular in the United States. It describes, and illustrates by a selection of some fifty photographs, all the usual phenomena, not only the depression and anticyclone, but also tornadoes, ice-storms, orchard damage by frost (together with the methods used to combat the latter), thunderstorms, and other items of weather. It makes no claim to be a text-book, but in the four sections in which it discusses the seasons in turn it gives quite a vivid picture of the weather of the seasons. The theoretical explanations are of the simplest character, and the author has avoided the topics which would have involved him in abstruse theory. He has naturally tended to choose his topics for discussion for their dramatic value, and has arranged the

material in a very different order from that of the normal text-book. There is however a very full index at the end, which adds much to the value of the book, and makes it possible to refer to any point on which information is desired without hunting through the whole book.

The teacher of meteorology or geography will find in this book much that is suitable for inclusion in his lessons, while the lay reader will find in it a fund of information not readily to be found elsewhere. The book is to be recommended as a vivid picture of the weather all the year round, treated from the standpoint of every-day life. The explanations are always clear, and are as complete as can be expected in a book for popular consumption. The illustrations have been selected with great care, and add beauty to a book which even without them would have been a useful addition to our library of books about the weather.

D. B.

BIOLOGICAL PROCESSES IN TROPICAL SOILS, with special reference to Malaysia. By A. STEVEN CORBET. *Cambridge: W. Heffer & Sons* 1935. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xiv + 156 *pages; illustrations and sketch-map.* 7*s* 6*d*

This volume is the work of a former bacteriologist at the Rubber Research Institute of Malaya, and is based largely on experimental work and field observation carried out at that Institute. It deals therefore primarily with the conditions prevailing in Malayan Rubber Plantations, but it should prove of great value to agricultural chemists, foresters, planters, and others working within the hot, wet equatorial belt in all tropical countries.

The author points out in his preface that, though much work has been done recently on the soil microbiology of temperate soils, comparatively little is known of similar processes in tropical soils, which differ fundamentally in their much lower organic content from those of cooler regions. An up-to-date account therefore of our knowledge of biological processes in tropical soils should stimulate further work on this exceedingly important aspect of tropical agriculture.

The first two chapters (pp. 1–34) are given to a brief description of the topography, climate, soils, and plant formations of Malaysia. The inclusion of these chapters in a specialized work is explained by the frequent lack of text-books in tropical laboratories and doubtless many workers fresh to Malayan conditions will find them useful.

The next two chapters deal with soil macro- and micro-organisms respectively. The very constant conditions of temperature and moisture obtaining in Malaysia, in contrast to the fluctuation in temperate regions, are reflected in a comparatively stable population of micro-organisms.

After a chapter describing the well-known growth curve of a pure culture of bacteria in a closed system, three chapters are devoted to a detailed consideration of the nitrogen content of tropical soils and the principle is enunciated that the content varies inversely with the amount of solar radiation.

In forest soils, where the temperature is 25° C., the nitrogen content remains constant, but in clearer areas, where the solar radiation is increased, the content drops and can be permanently increased only by adequate shading. The practical application of this principle is considered in the final chapter where such matters as burning cleared land and the use of cover crops and fertilizers are dealt with. This chapter will prove of the greatest value to planters and others practising tropical agriculture.

Five appendices (including standard methods of examining soils and a classification of the bacteria and fungi) and a very full index complete the volume, which is illustrated with diagrams and plates. The latter are mostly

well-known views of vegetation, or individual plants, and do not, perhaps, illuminate the text sufficiently to justify their inclusion and the consequent somewhat high price for a book of 156 pages. J. S. L. G.

AN INTRODUCTION TO PHYSICAL GEOLOGY (with special reference to North America). By WILLIAM J. MILLER. 3rd Edition. *London: Chapman and Hall* 1935. 9×6 *inches;* xii+465 *pages; illustrations*

This text-book is evidently popular, since the first and second editions, dated 1924 and 1927 respectively, were each reprinted twice. Such popularity must however be mainly confined to North America and especially to the United States, from which almost all the examples and illustrations have been taken. In this country teachers of geology and geography may find it useful, more particularly on account of the many admirable illustrations, but discretion will be necessary in the selection of material. The subjects treated are those usually included as "Physical Geology" in America, though hardly what would be expected from the title in England: thus the physics of the Earth are barely touched upon and there is no discussion of the magnitude of Earth forces or their adequacy as causes of crustal movement, folded mountains are dismissed in a few lines with no mention of nappes or windows, nor is there any allusion to continental drift. The definition of a mountain chain as consisting of two or more systems or ranges formed at distinctly different geological times is not likely to be generally accepted.

The chapter on volcanoes is good, but the sections dealing with igneous rocks and their modes of occurrence surprisingly elementary: basic and acid rocks are not distinguished, magmatic differentiation is hardly touched upon, and there is no discussion of temperature and pressure in relation to chemical action. Ring-dikes are not mentioned and the definition of a volcanic neck as "the hardened lava which fills the feeding channel (or conduit) of a volcano" is inaccurate; necks filled with tuff or breccia are probably more numerous than those filled with lava.

Such subjects as might be called physical geography, for example the work of streams, glaciers, the sea and wind are well described and illustrated, though the choice of technical terms seems curious to an Englishman: on a single page (p. 199) we find Bajada, Bolson, and Pediment defined, whereas such familiar terms as "postponed junction," "meander core," or "dreikanter" are not used, though the phenomena are briefly described. Many of the words and phrases used seem out of place and unduly "popular" in a text-book of the high class to which Professor Miller's work undoubtedly belongs. Although a table of geological periods is given in the first few pages, fossils are described as "millions of years old" with irritating monotony; the animal life of the shallow waters of the sea is said to include "many shelled forms such as clams, mussels, and barnacles"; and the invariable use of the term "carbonic acid gas" led the reviewer to turn back to the titlepage to verify the date of publication! It may be impertinent to criticize the English of a book essentially American, and some snappy phrases which would not ordinarily be accepted in a text-book by an English publisher are welcome as likely to stick in the student's memory; but a "perfect peneplain" and "highly subdued topography" seem self-contradictory, while the statement that in deserts "frost-action, due to lack of water, is comparatively unimportant" might surely be amended.

We have alluded to these minor points because we are certain that the many good features of the book will ensure its continued popularity and that further editions will be called for. C. N. B.

WE EUROPEANS: A Survey of "Racial" Problems. By JULIAN S. HUXLEY and A. C. HADDON; with a chapter on Europe Overseas, by A. M. CARR-SAUNDERS. *London: Jonathan Cape* 1935. 8×5½ *inches; 300 pages; illustrations and maps.* 8*s* 6*d*

The book under review is a convincing presentation of the scientific case against the pseudo-science of "racial biology." It states in a compact and logical form the present position of our knowledge of the science of heredity in man, and an historical chapter indicates how numerous and alluring are the fallacies which have, at many periods, entrapped the complacent critic of other "races" than his own. The linguistic criterion of race receives, as might be expected, especial consideration, since this lies at the root of the Aryan nonsense that flouts the anthropologist and mocks the scientific mind. But the will to believe, and the power to make others believe or conform, does not depend upon the truth of a dogma, and an autocrat needing a prop for a policy is no respecter of the verities, eternal or other. The danger of the present tendency in Europe lies in the fact that most people follow a leader, especially if he leads them towards promised, or unpromised, lands. National fanaticism is like any other type of emotional possession, and it is stimulated by an assurance of community of race and blood. How illusory is such an assurance, as applied to the mongrel peoples of Europe (and elsewhere), is the main thesis of 'We Europeans.'

It would be unfair to the book to give the reader the impression that it is nothing more than an attack on propagandist anthropology. It is much more than that, and all of us can profit by its teachings. One of the most valuable of its features is the emphasis laid on the fact, too often ignored or even denied, that distinctions between peoples (apart from a few physical characters) which are conventionally regarded as racial are really cultural: "Habits, traditions, machines, dress, art, institutions, gestures, ideas—all these as well as language are part of the social environment of human beings. They are not inborn, but have to be learnt or built up by experience" (p. 271). Recognition of the extent to which a "national temperament" may be moulded by circumstance, or by dominant individuals, so that even a peace-loving people may become bellicose in a generation, can inspire us with no confidence in the future of Europe.

The remaining sections of the book are those which deal with the "Bases of Ethnic Classification," and some of the associated pitfalls and fallacies; the "Main Ethnic Groups of Europe"; the "Ethnic Composition of European Nations"; and "Europe Overseas." The section in conclusion gives a summary of the argument, cogent and concise. But at one moment, and only one, the authors found themselves in prophylactic vein: "The cure for the racial mythology, with its accompanying self-exaltation and persecution of others, which now besets Europe, is a re-orientation of the nationalist ideal, and, in the practical sphere, an abandonment of claims by nations to absolute sovereign rights" (p. 287). A prescription—or a dream?

The book is distinguished by vitality of thought and clarity of diction, and its translation into other Aryan languages is much to be desired. H. S. H.

RACE, SEX AND ENVIRONMENT: A Study of Mineral Deficiency in Human Evolution. By J. R. DE LA H. MARETT. *London: Hutchinson's Scientific and Technical Publications* 1936. 9½×6 *inches; 342 pages; diagrams and maps.* 21*s*

Mr. Marett could scarcely have chosen a more appropriate moment for the appearance of his first book. The recent creation of an International Committee to investigate the whole question of nutrition and its effects upon human welfare has stimulated public interest in the subject, and directed the attention of

geographers in particular towards its possible repercussions. In the circumstances a scientific inquiry into the relationship between nutrition and human evolution was bound to awaken considerable interest; but one was scarcely prepared for the magnitude of the conclusions drawn by the author, for Mr. Marett believes that he has found here the clue to the whole complex subject of environment and race. He advances a complete new theory of evolution based essentially upon this question of nutrition.

"It is a commonplace of science," he writes, "that a causal connection must exist between environment and race. . . . The following inquiry has thus resolved itself into a search for causes: that is to say, into an attempt to associate the discordant categories of the organic and the inorganic by as close a nexus as the existing evidence allows." The bridge between the two, so long sought after by many branches of science, Mr. Marett believes to lie in the various mineral salts upon which all living organisms depend for normal metabolism. Variations in the available supplies of these minerals will, he thinks, be reflected in variations in the metabolism of individual organisms, leading to phylogenetic adaptations of the whole species to meet the changed conditions. The initial variations in the available supplies of these "key minerals"—of which iodine, calcium, and phosphorus are regarded as the most important—are explained by climatic variation in geological time. Thus we arrive at a complete chain of cause and effect: the various stages in the evolution of man are correlated directly with the mineral content of the food he eats, the latter with the constitution of the soils on which he lives, this in turn with the nature of the climate, and climate itself with varying solar radiation. "Present heredity," claims the author, "is moulded by past habitats." Modern man is the product of various mineral deficiencies in the diets of his remote ancestors—a conclusion which reminds one forcibly of Fauerbach's famous dictum: "Man is what he eats."

Mr. Marett was led to this theory by a study of Sir John Orr's work on the effects of mineral deficiencies in pastures, and was especially inspired by the work of the Russian school on the relationships between climate and soils. The first section of the book is largely concerned with an attempt to correlate these two lines of evidence. A somewhat detailed analysis of the physiological functions of the various minerals concerned and the known effects of deficiencies is followed by a geographical survey of soil types in conjunction with, for example, the distribution of goitre, known to be connected with iodine deficiency. No very conclusive correlations are found, but Mr. Marett mars his arguments here, as elsewhere, by some inaccuracies in his statements. Thus we are told that in the British Isles "Cretaceous deposits are confined mainly to the North and South Downs," while in Europe "the mountains to the East of the Rhône, together with the Rhône valley itself, are Cretaceous . . . these same deposits go to form the Alps. . . ." Wegener's theory of Polar Shift is invoked to explain certain anomalies in the mineral content of African soils, but Mr. Marett does not show himself very familiar with all its implications.

In this first section also the main postulates of the theory are laid down. Soils rich in calcium—resulting from arid climate—are believed to encourage skeletal growth and large size. Conversely shortage of calcium, the result of humidity, will result in reduced size and increased sexuality. Iodine deficiency will similarly have various rather obscure effects. Evolution, in short, has been guided by the mineral deficiencies of the various habitats in which species have found themselves, natural selection, and sexual selection, preserving types specialized for economy of these substances. Thus random selection and mutation are replaced by definite environmental control, the intermediary between the external environment and the intra-nuclear environment (which governs

the somatic expression of gene-groups) being the endocrine glands. This idea is interesting as supporting Sir Arthur Keith's frequent suggestions that the endocrines have played a large part in the differentiation of "races."

In the second half of the book this general thesis is applied to the evolution of man himself, and leads the author to some astonishing conclusions. Man is held to have initially evolved "on the rising Tertiary limestone mountains," which introduced a new type of habitat, deficient in iodine. The great apes, it is suggested, "may be degenerate Hominidae," although the author admits that "many would doubtless regard this notion as too far-fetched for either consideration or refutation." The adoption of upright carriage, expansion of the brain and skull, and loss of body hair, in the case of man, "are all viewed as the result of atavistic, and probably rapid, reactions to mineral deficiency." Iodine deficiency would appear to be the main *deus ex machina* in each case, but the author is forced to exhibit considerable ingenuity to explain the many contradictions which arise. The conclusion reached however is that "primitive" man was a brachycephalic pygmy, evolved on the Tertiary mountains. Later he appears to have re-entered the forests, and eventually we find two distinct sub-species of man evolved—a Southern forest type, small and with a high metabolic rate, and a Northern, coarser-boned and developing more slowly. Mr. Marett is forced to create these two quite hypothetical stocks to explain the combinations of diverse characters exhibited by the fossil Hominidae, all of which he regards as mixed "racial" types. Neanderthal man is explained as a late development, his great skeletal development resulting from the richness in lime of his Tundra habitat.

Finally modern man is examined. Here again revolutionary explanations are offered. All modern "races" are regarded as mixed. Negroes, Bushmen, and African Pygmies are held to be descended from the original pygmy Southern stock, the Negro being "an enlarged Pygmy, adapted to . . . tropical park-lands"; the Bushman "an ultra-feminine negro," his unique skin colour, peppercorn hair, and even his steatopyga being adaptations to his arid environment. Incidentally Mr. Marett is here again guilty of loose phraseology, as for example in referring to the "Japanese, Burmese, and Korean races." The book is completed by an attempt to correlate these theories of mineral deficiency and its effects on sexual selection with social institutions. Nothing is omitted. Marriage customs, religious ideas, individual and group psychology are all considered. In the last chapter the final step is taken, and the subject is brought into the field of modern politics. In general the author believes man to have evolved towards increased femininity and increased numbers, on account of their survival value in terms of minerals. The book ends on a gloomy note foreseeing these tendencies accentuated, and the world supplies of these vital minerals steadily decreasing.

This outline of the scope of the book will indicate sufficiently well its main ideas, and also its major defects. It is essentially a pioneer study, and Mr. Marett deserves all praise for indicating the possible importance of an aspect of the subject previously curiously neglected. Since little data exist on many of the points essential to his theories, it is only to be expected that many of the hypotheses put forward are in the nature of guess-work. The book teems with revolutionary ideas and suggestions, many of which will probably horrify orthodox scientists, but most of which ought at any rate to stimulate controversy and new research. The major criticism is that the author has tried to explain too much. He has a valuable idea, but, as so often happens, he has not made enough allowance for other factors. Many of his suggestions are wild, some rather contradictory. His arguments are occasionally marred by inaccuracy

of statement, and he assumes an acquaintance with biological theory and terminology which makes it hard for the general reader to follow all his arguments. In spite of these defects however the book is an important one. Mr. Marett may be proved wrong—at any rate in part—but if he succeeds in attracting sufficient interest to result in the solution of half the problems he raises, he will have performed a valuable service. To the geographer at any rate his book will remain of lasting interest as representing a serious attempt to elucidate the fundamental connections between environment and race. R. F. P.

THROUGH THE WEATHER HOUSE: or the Wind, the Rain and Six Hundred Miles Above. By R. A. WATSON WATT. *London: Peter Davies* 1935. $7\frac{1}{2} \times 5$ *inches;* xii + 192 *pages; illustrations.* 7*s* 6*d*

This book is an expanded revision of seven talks which the B.B.C. invited Mr. Watson Watt, of the Radio Research Station, Slough, to give in the National Programme early in 1934. The title signifies that the atmosphere with its thermal stratification is likened to a house of many storeys, and the analogy is worked out in some detail with considerable skill. Nevertheless allegory of this kind is to be deprecated as a forced, unnatural way of introducing an open-air study like the weather to the general public which might surely have been appealed to directly, by abundant reference to the beauty of the sky and clouds amid the wide spaces of land and sea. The exposition of meteorological facts, principles, and theories is, as one would expect from a meteorologist of the author's standing, very good. The last chapter entitled "Further Outlook——?" summing up the present position of meteorology, strikes a somewhat pessimistic note. Even if the tremendous geographical difficulties in the acquisition of adequate observations could be overcome, a battalion of workers would require six weeks from to-day to calculate the weather of to-morrow from the data. When the Newton of meteorology arrives his system, says the author, will be revolutionary rather than evolutionary.

One or two slips and shortcomings call for remark. Thus on p. 84 it is obviously erroneous to state that for the purpose of reducing barometric readings to sea-level the temperature of the air column is assumed to be that indicated by the thermometer attached to the barometer. On p. 58 an explanation of cloudbursts stops short of the critical question whether the law limiting the size of rain-drops breaks down on these occasions and whether the rain really does fall in the solid streams and spouts to which eye-witnesses testify. Again, on p. 59, the "helm" cloud of Crossfell Edge (which incidentally is not in the Peak District) is referred to only as a local cloud shape whereas it is really just a particular case of the familiar but very puzzling phenomenon of hill-fog of which no other mention is made.

The book is embellished by a number of cloud photographs but hardly by a frontispiece design of the Weather House very much in the style of a skyscraper.

L. C. W. B.

THE MONTHLY RECORD

EVOLUTION OF THE LA PAZ BASIN

A large folding-map of the "Cuenca" of La Paz, on the scale of 1/15,000, is published with *Petermann's Mitteilungen* for December 1935. It is the result of a photogrammetric survey carried out by Dr. Karl Troll in 1928, and plotted under the supervision of Dr. R. Finsterwalder, who discusses the technical procedure and the degree of accuracy obtained. The area is contoured at intervals of 20 metres, with oblique shading in brown. Indications of the geomorphology and vegetation have been added: eucalyptus groves, fields, the uncultivated "puna" steppe, irrigation systems, and similar information are shown by various symbols in green.

The geomorphological features, shown in black, are described and explained by Dr. Troll in the accompanying article. After a study of the stratigraphical and morphological evidence for its diluvial history, he puts forward some tentative conclusions on the origin of the basin. The *cuenca* is to be sharply distinguished from the adjacent *altiplano*, a portion of the undisturbed plateau moraine surface.

A conspicuous feature of the valleys which unite to form the upper La Paz are the broad terraces often with level surfaces, and, if covered with river deposits, with steep edges. The lower valley slopes around La Paz consist of fine sandy beds. These areas, broken up by steep ravines and falls of stones (barranqueros) and characterized by frequent "soil flow" during the rains (terrenos blanquizcos movedizos), have been compared to the "badlands" of Dakota. Towards the Cordillera the stony material increasingly predominates, the river debris being replaced by morainic material. The most conspicuous of these terraces is that upon which the suburbs of Sopocachi and Miraflores stand. At Calacoto the terrace lies about 80 to 100 metres above the present valley, at Miraflores this height has decreased to 50 to 60 metres, and continues to decline up the valley. Two other terraces can be distinguished, at about 150 metres and 240 metres above the Miraflores terrace. Other features of the valleys are the concave nicks or arcs cut into the edge of the high plateau: these are not the work of rivers, but are produced by great slides, due to rapid erosion of the sandy lower layers. These slides, if confined by the narrowing of the valley lower down, can produce scratches on rocks remarkably like glacial *striae*, which makes the writer sceptical of reports of glacial action in the lower La Paz Valley.

Previous students of this area had concluded that it had been subjected to two or even three recent glacial advances, and that the La Paz valley is a *Trogtal* modelled in the unconsolidated deposits by glaciers descending to La Paz, where the boulder-rich deposits were thought to represent remains of their ground moraines. Dr. Troll believes that these valleys have not been occupied by glaciers since the plateau morainic material, in which they are cut, was deposited, and that they are the work of rivers, melting glacial water, and the slipping of the valley sides. The sequence of events is a penultimate glaciation, during which the *altiplano* morainic material was deposited, a period of valley building, and then a last glaciation, the glaciers of which did not reach La Paz. Evidence on the formation of the valley profile is afforded by a layer of volcanic tuff, 6 to 9 metres thick; this appears to have been laid down upon a surface sloping gently from the Cordillera to the *altiplano*; below it are found the fine sands and clays associated with the "Badlands" (Lower La Paz formation). Above the band is a layer of clayey ground-moraine with great granitic

boulders, capped by distinct horizontal beds of rubble which merge into the *altiplano*. The tuff bed therefore had been laid down upon the debris-covered gently sloping foot of a mountain range by ever-changing streams, *i.e.* upon the Lower La Paz formation, the age of which is tentatively concluded to be early quaternary.

The edge of the *altiplano* coincides with the edge of the upper valleys of the La Paz, partially occupied by glaciers. The three terraces below the level of the plateau, covered with river gravels and with undisturbed surfaces, are proof that the valley cannot have been filled by a glacier. The factors in the extensive development of the basin have been the diversion of glacial water from the Titicaca drainage basin, the advance of the lower La Paz working at a deeper erosion level, and the character of the Lower La Paz Formation.

WATER SUPPLIES IN THE ANGLO-EGYPTIAN SUDAN

In Bulletin No. 2, published by the Geological Survey of the Anglo-Egyptian Sudan, Mr. G. W. Grabham has made available some of his long experience with the most pressing need of the Sudan—water. It is not a highly technical account intelligible only to the geologist and engineer, but is purposely written for the official who wishes to improve the dry-season water supply of his district. It should be of great value in nearly all African territories.

Many of the supplies are well known in some districts, but they are here collected and explained for the country as a whole: moreover precise instructions are given for maintaining and improving reservoirs of all descriptions, preserving sanitation, construction of wells and drilling. There are some valuable notes on the consumption of water by domestic animals in hot and cold weather, on losses by evaporation and means of reducing them, and so on. The book is a mine of practical experience and information, and it is strongly to be recommended for general use in semi-arid countries. It may be read with advantage by residents in this country as a lesson in the real meaning of the struggle against an insufficient water supply, against lack of rain alternating with an excess that destroys storage works or fills them with silt, with a need to provide for rainless years. It will come as a surprise to some readers in this country to learn that water may be stored in closed tanks or hollow trees for periods of years as an emergency supply. A soil map of the Sudan is included. K. S. S.

CHANGES IN LAND UTILIZATION IN SOLLING

We have received from the author, Dr. Erika Reddersen, a copy of her monograph, published by the Niedersächsischer Ausschuss für Heimatschuss, on the changes of the "Landschaftsbild" of Hannoverian Solling since the early eighteenth century. This amounts to a survey of the economic and social changes in a typical portion of the north-west highlands. Using cartographic and documentary sources, commencing with the De Villiers maps of 1698–1720, she has compiled a map of the region on the scale 1 : 100,000 which shows all the later changes in land utilization. The region consists of a forested area, and a "foreland" predominantly agricultural: it is interesting to note that although 2400 hectares of forest have been cleared since the early eighteenth century (approximately one-half for agriculture and a quarter for gardens), since the end of that century 2100 hectares have been planted, effecting some change in the character of the woodland which, formerly oak and beech, is now one-third pine. During this period there has also been a great increase in the cultivated land at the expense of the pasture, with improvements in drainage and farming practice. It is not perhaps surprising therefore to find that the rural population, which was 33,374 in 1806, far from declining, showed in 1925 an increase to

40,821. Over the period 1821–1905 the town population had grown from 11,400 to 16,500. Most of the land is in average or large peasant holdings.

HYDROLOGY OF KILIMANJARO REGION

A Government "Report on the Investigation of the Proper Control of Water and the Re-Organization of Water Boards in the Northern Province of Tanganyika Territory" is based on field work which the authors, Dr. E. O. Teale and Mr. C. Gillman, were appointed to undertake in November and December 1934 (Dar es Salaam 1935). Irrigation as practised in this region is of a somewhat unusual type, and so variable are local conditions in relation to native tradition and white settlement that it presents many difficult legal problems in the Arusha and Moshi Districts.

The authors lay stress on the peculiarly interesting and complex geography of the Kilimanjaro and Meru mountain regions and the astonishingly sharp contrasts shown in both horizontal and vertical distributions. Instances, they say, are frequent where rain-forest trees abut on plant forms of an arid climate and coffee may be seen growing adjacent to sisal; or, on the other hand, where a journey of a couple of miles may take one across a narrow weather parting from a dry into a rainy season. Among a number of recommendations made in the Report special emphasis is laid upon the necessity of preserving the forest belt on the mountain slopes, as this is shown to be the chief source of the permanent springs and rivers which maintain so dense a population on the slopes and in the foreland. The prevailing notion that the ice-cap on Kilimanjaro is the main source of both the surface flow in the streams and of the underground waters which feed the numerous springs is, the authors are convinced, entirely wrong. It is not denied however that the ice-cap has an important influence on the general weather of the vicinity especially on air-currents, clouds and mists, thereby indirectly increasing the water supply of Kilimanjaro. The statement that the most important part of the water which falls on the mountains is collected in the forest zone does not imply support of the frequently expressed view that the forest itself increases the rainfall. The forest, on the contrary, is the result of the favourable rainfall, statistics about which together with a discussion of the prevailing winds being given in an appendix. Nevertheless the forest with its litter and soil acts as a most efficient regulator for the run-off, and by intercepting the mists and clouds increases the available water supply. The distinction that is noted between the rain-forest and the mist-forest above it is a very interesting one, only apparently to be seen to advantage on high tropical mountains. It raises however the question whether difference of temperature as well as difference in the type of condensation is not concerned in the differentiation of the two types of vegetation. In what proportions the rain and mist forests contribute to the available water supply cannot at present be determined.

The erosive action of the streams on the steep slopes has cut deep canyon-like valleys which, intersecting alternating layers of lava and ash, tap powerful springs, locally known as "chem-chems," of great importance in maintaining the Pangani and other streams during the dry season. The most powerful springs of all emerge round the base of the mountains especially on the lower southern side, often indeed far out on the dry steppe.

THE BURUSHASKI LANGUAGE

Two volumes recently published by Colonel Lorimer form the first attempt to deal systematically with the Burushaski language. (The Burushaski Language. By Col. D. L. R. Lorimer, 2 v. Oslo: Inst. for Sammenlignende Kultur-

forskning, 1935). It is spoken by about 20,000 inhabitants of the out-of-the-way valleys of Hunza, and its special interest is that although occurring at the meeting-place of three linguistic families, the Indo-European, the Tibeto-Burman, and the Turkish, it is unconnected with them. Professor Morgenstierne, in his preface, discusses some of the suggested affinities, and holds that its relationship to the Caucasian languages, which some scholars have advanced, has yet to be proved. It is not possible here to review critically so specialized a volume, the outcome of Colonel Lorimer's long association with these people. Of more general interest are the few pages in which he describes their home, daily lives, and character. A third volume containing the vocabulary is in the press. The Institute for Comparative Cultural Research at Oslo has performed a useful service in making this pioneering research available to students of linguistics.

THE ATLANTEAN CONTINENT

Mr. H. E. Forrest has recently produced a second edition of his book ' The Atlantean Continent: its bearing upon the Great Ice Age and the distribution of species,' and the Society has had the good fortune to secure the opinions of two eminent geologists, Dr. Morley Davies and Professor J. K. Charlesworth, on the real worth of his speculations. " The thesis of the book," writes Dr. Morley Davies, "is that the former existence of an Atlantean continent, uniting North America to Europe and North Africa, and rising northwards (around Greenland and Iceland) into a high mountain chain, the Atlantean Alps, explains the great Ice Age and many puzzling facts of plant and animal distribution. Such a vanished continent has had a fascination for many imaginative minds, but when attempts are made to escape from vagueness, the extent of the continent alike in space and time is found to vary enormously with the evidence regarded as most important. As with the rival theory of the separation of America from Europe by continental drift, evidence which by itself might secure a conviction provides an *alibi* as against some other equally convincing evidence. According to the present work, the Atlantean continent began to sink below sea-level in the latter part of the Ice Age: before that, the present coast of Iceland stood many thousand feet above the coast-level of England. Yet marine Pliocene deposits like the East Anglian Crags, containing the same fossils, are found along the present coast of Iceland—so that the Atlantean Alps must have been upheaved in late Pliocene time and depressed to the same amount in late Pleistocene. But others ask for an Atlantean continent in or before the Pliocene period, to explain migrations. We are dealing with a tangled skein of evidence which it will take long to unravel.

"The author believes that a great ice-sheet moved radially outwards from the Atlantean Alps over North America and North-West Europe, crossing the British Isles with little regard for the local topography. Since the first edition was issued in 1933, he has been led to modify this conclusion in some details; but he still rejects the accepted view of local radiations from Snowdon and Arenig, based on detailed mapping of erratics, and he is not likely to find followers among the local geologists. He has brought together a mass of valuable evidence (not new) as to animal and plant distribution, which points strongly to some form of transatlantic land connection at some time; but a witness who can swear to an event but cannot be sure how long ago it happened is not much use in the law courts."

"For his main foundation," writes Professor Charlesworth, "the author naturally delves into British glacial literature, though his pages dealing with the eastern part of the British Isles are quite irrelevant from his point of view

since on any theory this part was overridden by ice flowing in his direction, namely from the north or north-west. In the critical west however where, according to the orthodox view, the ice passed out to sea, the author has no evidence to offer for his ice-sheet advancing on to the land. This crucial difficulty he evades either by suppressing or misreading trustworthy but, for him, awkward facts, available in the literature, or by making naive assumptions as unjustifiable or gratuitous as that by which, elsewhere in his book, he attributes the early Scandinavian glaciation of our eastern coasts to ice issuing from Spitsbergen.

"Numerous glacial matters of a minor nature betray the author's lack of the bibliographical knowledge and geological field experience that are requisite for such studies. The drumlins are turned the wrong way round to point their steep faces downstream; the discarded evorsion hypothesis of Geinitz is revived for the kettel-holes; the fjords are cracked open by upheaval; and the North Channel is wholly excavated by ice, giving this a potency that is incredible in these days. On the main question, it can with quiet assurance be said that while there are admittedly many floral and faunal distributions that still await their final explanation, some of which have led the author to his surmises, Mr. Forrest has written nothing to shake the geological edifice so carefully erected by the patient labours of the past."

MEMORIAL TO THE LATE DR. MARION NEWBIGIN

The Royal Scottish Geographical Society propose to raise a fund for the establishment of some memorial to the late Dr. Marion Newbigin who for thirty years edited the Scottish Geographical Society's magazine, and they invite subscriptions from her friends, of whom there must be many outside the Scottish Society who will wish to take some part in commemorating her services to geography. Subscriptions should be sent to the Treasurer, Royal Scottish Geographical Society, Synod Hall, Castle Terrace, Edinburgh.

THE OXFORD UNIVERSITY EXPEDITION TO NORTHEAST LAND

A note in the Record of the *Journal* for October 1935 referred to the establishment of the Oxford University Arctic Expedition of 1935–36 led by Mr. A. R. Glen at their base in Brandy Bay, just west of the northern cape instead of in Rijps Bay just east of it as had been intended, but which proved impossible owing to heavy ice. From time to time reports from the expedition have been published in the *Times*. A message from Brandy Bay dated January 6 published on January 11 related that the weather had so far not lived up to its evil reputation, and Brandy Bay was only then just safe for sledging. The two ice-cap stations set up in September had been maintained successfully and the parties relieved at intervals. A sledge party of two, Messrs. Croft and Wright, had succeeded in reaching Cape Leigh Smith and establishing there a depôt for the surveys of the north-east coast in the Spring.

In the *Times* of March 7 there was a further report dated from the Base Camp on March 3. The design of the two ice-cap stations had proved very successful, and much experimental work had been done in shafts driven down into the glacier. At the northern station it had been shown that the ice-cap is rapidly diminishing, and observations over the sea to the north from this elevated position had shown that there was much open water, sometimes as far as 82° north until early in February. The northern station, having completed its programme, was evacuated late in the month, but the central station will be maintained until June. At the base hut the observations on ionization and ozone in the upper atmosphere had been carried through successfully.

This dispatch was supplemented by a message to the Society from Mr. Glen

dispatched on March 5. Three depôts had been laid for the Spring survey of the coast and Lieutenant Godfrey was planning a survey of the western ice-cap edge joining the new surveys with the stations of the Russo-Swedish Arc of Meridian. The astronomical determinations of longitude by meridian transits and prime vertical altitudes had shown that Arctic refraction was apparently exaggerated.

From these reports it is highly satisfactory to gather that the whole party had maintained their health and efficiency in the severe conditions of Northeast Land, and that all looks well for a successful completion of their ambitious programme.

CORRESPONDENCE

A REGIONAL GEOGRAPHY OF THE BRITISH ISLES

I am grateful to the reviewer, in the January issue, of my book on 'The British Isles' for pointing out some slips, but there are also a number of expressions of opinion with which I cannot agree though I recognize his right to state them. Some of his comments however give wrong impressions, or make positive though of course unintentional misstatements; it is impossible here to deal with all such criticisms but may I indicate a few of the points?

1. The reviewer states that a typical plateau stow of the South Downs "is made to include such markedly contrasted parts as the Chalk Downs and the Littlehampton–Worthing tract," but I do *not* include this coastal area in the South Downs region; it is dealt with on p. 85 as an extension of the Hampshire Basin.

2. His next sentence gives a wrong impression, for he implies that there is a discrepancy from geographical practice in my treatment of the Isle of Wight, saying: "Professor Unstead finds it only a complex stow." The reviewer misquotes my term "composite" stow, and appears not to have realized its definition: "a region which comprises areas intimately associated in situation, but of contrasted characteristics due . . . to the inclusion of different structural elements . . ." (p. 87 and 283).

3. He says: "there is only a casual reference in the bibliography to 'maps on various scales.' " My wording is: "The maps, on various scales, issued by the Ordnance Survey and the Geological Survey, are indispensable for careful study," and I deliberately refrained from specifying particular maps or editions, because of the constant issue of new ones and in the expectation that readers would apply for the lists which are frequently brought up to date by the Surveys.

4. He writes: "Of the thirty maps in the book twelve are maps of solid geology and their use is surely a retrograde step when by placing them opposite maps of geographical regions a direct correlation is suggested." A direct correlation is not suggested; on the contrary comparison of the maps shows great differences which are integral parts of the regional treatment. It seemed wise to use a uniform system of solid geological maps throughout the British Isles, but the distinction between the solid geology and the drift is explicitly and frequently indicated in the text and finds expression in the maps; this is perfectly apparent in the case of East Anglia to which the reviewer makes special reference. As for his reference to the maps of the northern coal-fields, there is the clearest contrast between the geological maps showing the exposed coal-measures and the

regional maps in which the coal-fields include also the areas where coal is mined from the concealed coal-measures.

5. The reviewer's criticism of the statement of "the position of leading buildings in London (p. 71)," seems intelligible only if it is intended to refer to the use of the names "Westminster" and "the City" as in the sentence "The National Gallery is not far from Westminster, and nearer the City is the British Museum." I am aware that the National Gallery is within the boundary of the administrative City of Westminster (though in popular parlance "Westminster" means the district around the Abbey and would scarcely extend north of Trafalgar Square), but in preceding paragraphs I had related the growth of London to its two foci, the City near London Bridge and Westminster at Thorney Island; my statement carried on this reference to these two great landmarks in the London region. Surely it can hardly be adduced as evidence of "looseness in thought or expression."

J. F. UNSTEAD.

MEETINGS: SESSION 1935–36

Tenth Evening Meeting, 2 March 1936. The President in the Chair

Elections: Miss Kathleen Babbs, M.A.; Charles W. Barber; Godfrey Baxter; B. Burgoyne Chapman, M.A.; The Reverend William Henry Clare; Conrad Reginald Cooke; Brother David, M.A., B.SC., LL.B.; The Venerable Archdeacon V. H. Donnithorne, M.A., M.C.; Criss Barrington Gyford; Joseph Taylor Huddart; Walter Ronald Moody; Hugh George Rea; Francis Hermann Gordon Ruoff; Eric Smith; Raymond Ansell Wells; Frederic Whittaker

Paper: A Journey in Rasmussen Land. By Mr. Augustine Courtauld

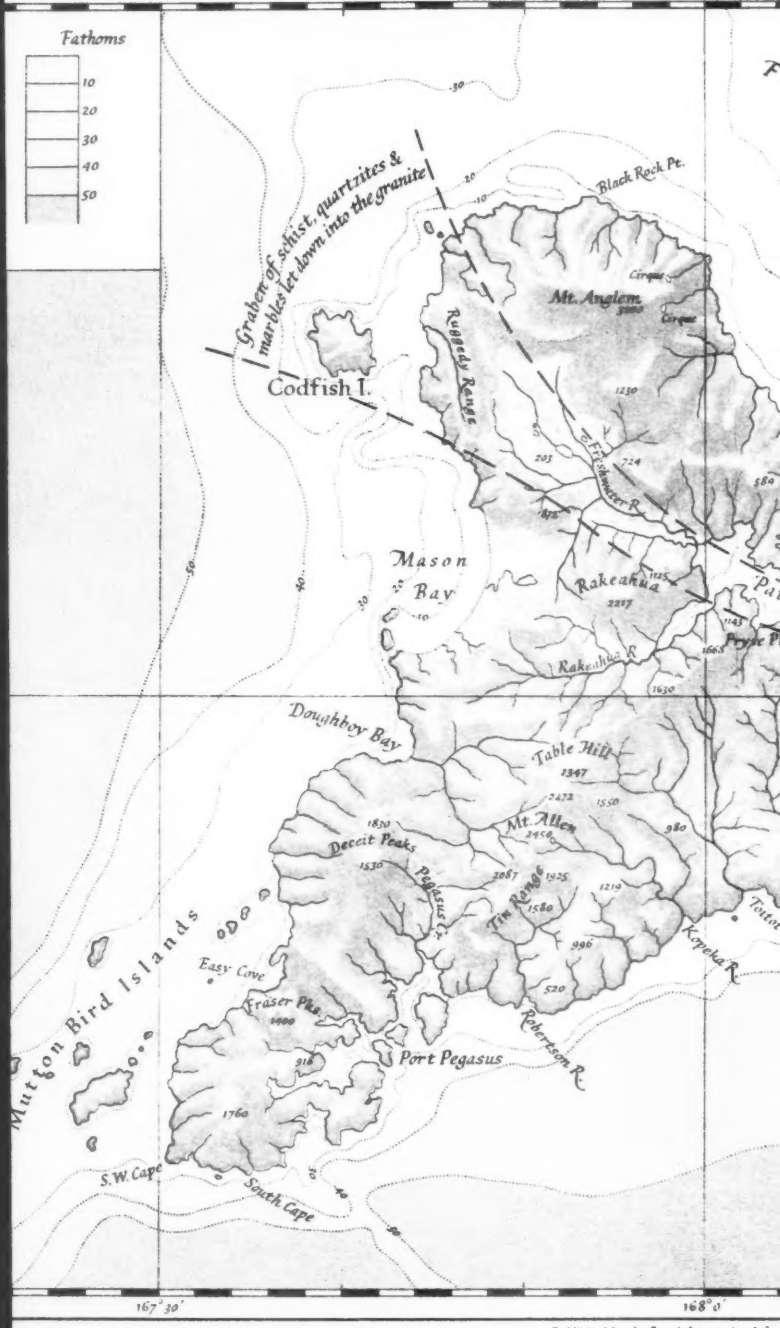
Fifth Afternoon Meeting, 9 March 1936. The President in the Chair

Paper: Variations in the Behaviour of the Peru Coastal Current. By Mr. E. R. Gunther

Eleventh Evening Meeting, 16 March 1936. The President in the Chair

Elections: Sir Thomas Bazley, Bart.; Mrs. M. Crofton; Edwin Gordon Donkin; Fred L. Emerson; J. Hackin; The Hon. Hubert Howard; Peter G. Mott; Mrs. Edith B. Phipps; Robert William Robson; Herbert Paul Theodor Rohleder, PH.D., DR.PHIL., D.I.C., F.G.S.; Brodie Jamieson Snyder; Humfrey Ewan Symons; Colonel Granville Walton; Hedley Belton Whitworth, M.A.; Captain James Jeston Vernon Wilson

Paper: Living with the People of Malekula. By Mr. T. H. Harrisson



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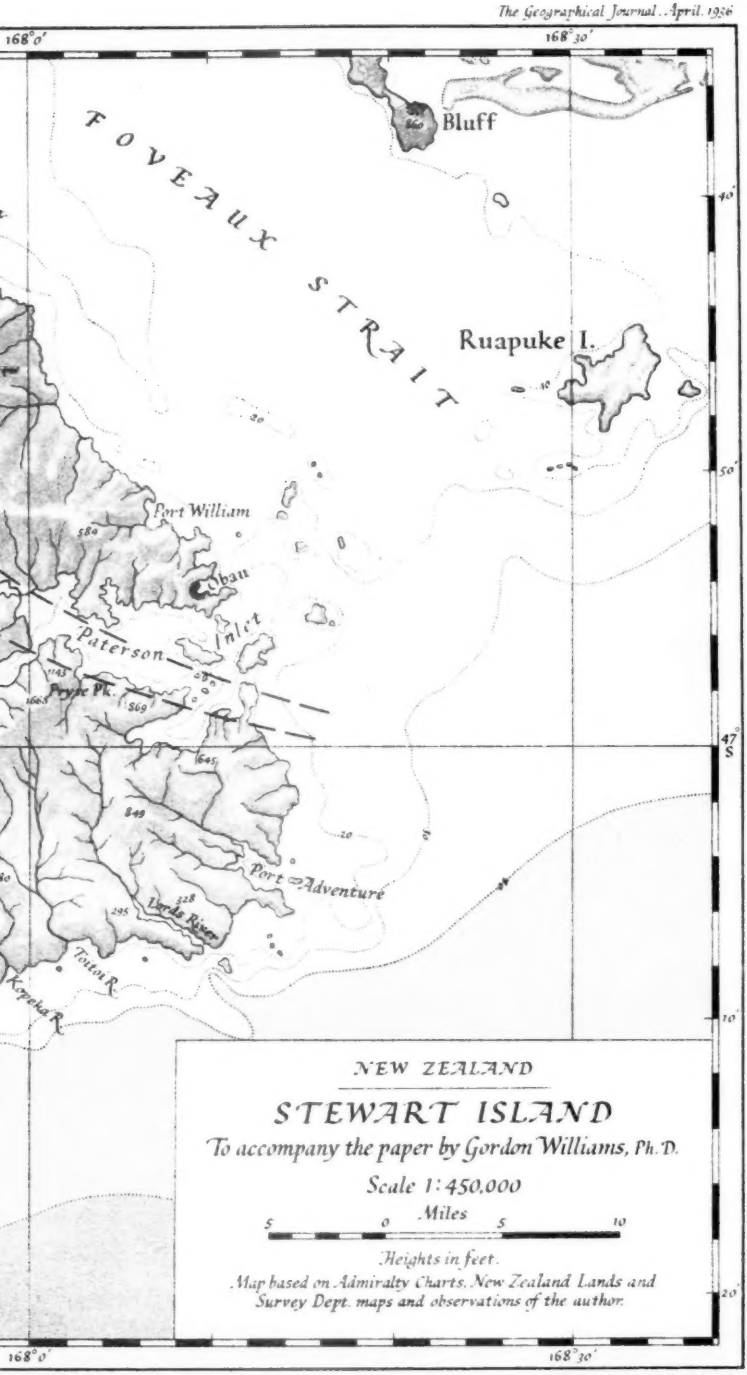


NEW ZEALAND

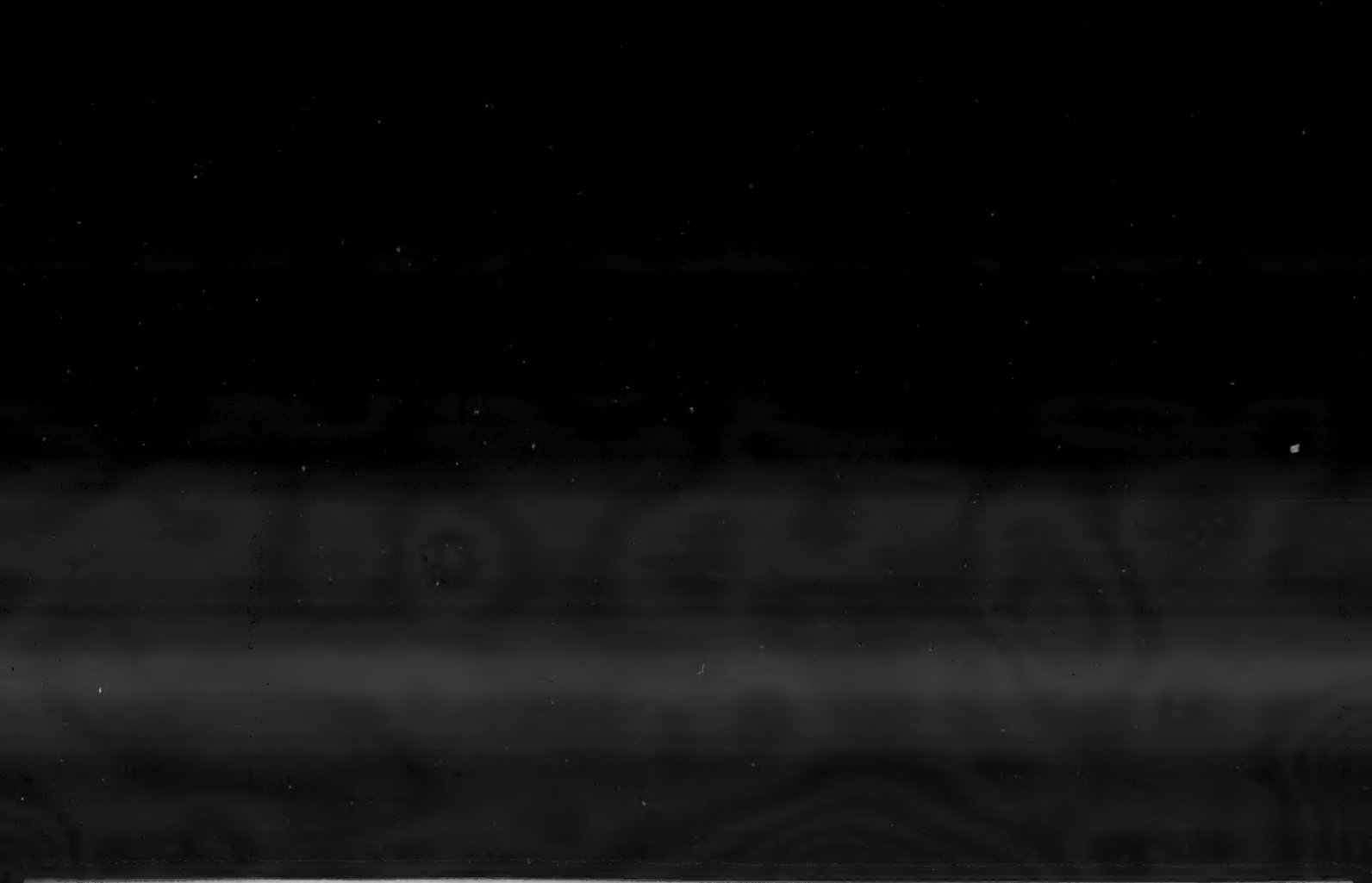
STEWART ISLAND

To accompany the paper by Gordon Williams, Ph.D.

Scale 1:450,000

5 0 Miles 5 10

Heights in feet.

Map based on Admiralty Charts, New Zealand Lands and Survey Dept. maps and observations of the author.

STEWART ISLAND
Williams